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POPULAR SCIENCE MONTHLY

APRIL, 1923; Vol. 102, No. 4 25 cents a Copy; \$2.50 a Year



Published in New York City at 223 West Thirty-ninth Street

Your Questions about Evolution Answered in Great Serial Story

ANOTHER gripping instalment of "The Story of Man and His World," Dr. E. E. Free's thrilling series on humanity's conquest of nature, appears on page 25 of this issue, to be followed by other instalments in subsequent issues of Popular Science Monthly. It is the story of man's ancestors and of his family tree, vividly and simply written.

Is man descended from monkey? Who and what were our ancestors? How and why was the complex machinery of the body invented? What was the origin of sex and the reason for it? What were the beginnings of the human mind? These are some of the questions to be answered for you in this series.

Publication of this series by Doctor Free, the foremost writer of popular science in America, is one of the notable feats of the year. Nothing like it ever before appeared in any magazine.

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ago by animals and by plants. It portrays clearly the drama of the earth, the heavens, and the waters. It tells the secrets of life itself.

"The Story of Man and His World" is a magnificent panorama of the whole field of science. It carries you away—away from aomber everyday life—to treasures of information and recreation. And it is written so that every one can understand it.

"The Story of Man and His

PAGE

World" is more than a fascinating narrative. It is a liberal education. It is a summary of the world's experience and knowledge. It is big and vital. It is amazing in its application to life today.

BEGINNING in our May number, the stirring picture of man emerging slowly out of the simpler forms of life will be described. His species and his subjugation of nature is to be depicted. It is a picture that will carry you through imagination-staggering time.

IN THE next few months Popular Science Monthly will publish the whole tremendous story, the greatest story that can ever be told to adults or to children. Simply and vividly written and superbly illustrated. Any one, no matter what his schooling, can understand every detail of it.

If you haven't begun reading this remarkable series, turn to page 36 of this issue. The May number of Popular Science Monthly containing the next instalment will be on sale at your pewsdealer's April 20.

Don't Miss These Big Features

POPULAR SCIENCE MONTHLY

Issued monthly. Simple copy, 25 cents. Tearly subscription to United States, its processing, and Canada, \$2,50; foreign constrict, \$3.

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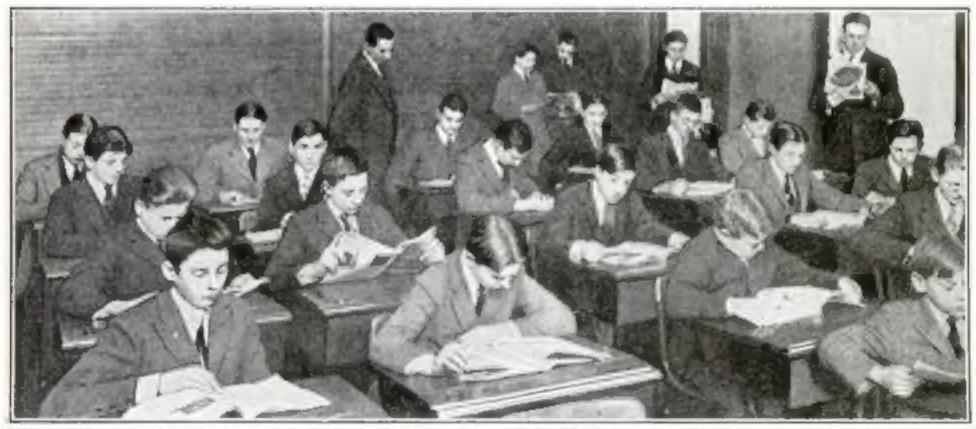
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How Popular Science Monthly Is Used in Schools



IN THIS classroom of the Huntington School for Boys in Boston, Mass., the thrilling adventure story of the world's beginnings, as well as the important news of current developments in general science, invention, and radio, is being unfolded from month to month by the pages of POPULAR SCIENCE MONTHLY.

Here the boys and their professors have or-

gamined a Popular Science Club, with Porulate Science Morrelly as their textbook. And here Doctor Free's great serial, "The Story of Man and His World," comes each month to feed the minds of these youngsters with scientific facts about their world and to fire their imaginations with episodes of its dramatic history, pictured in understandable terms.

The Popular Science Club meets once a week for an hour. Each boy is supplied with a copy of the current issue of Popular Science Monteur.

Every week a certain number of the boys are assigned to lead a general discussion of some scientific or mechanical subject that has interested them in this magazine.

Copy (grand manna)



No need to wait for hours in the rain

Attend the opera and concerts as often as you have the opportunity, for great music should be part of every one's spiritual development. But on a stormy evening, how you will enjoy hearing the great artists through the medium of the Victrola and Victor Records in the comfort of your own home! Artists of your own choice in programs of your own choosing, such is the service at your disposal by means of the Victrola.



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Both Are Embarrassed-Yet Both Could Be at Ease

HEY started out happily enough at the beglaning of the evening. He was sure he had found ideal companionship at last. She was sure that she was going to impress him with her

charm, her cultured personality.

But everything seemed to go wrong when they entered the restaurant after the performance at the theatre. Instead of allowing her to follow the head walter to their places, he preceded-and when he realized his mistake he tried to make up for it by being extremely polite. But he made another humiliating blunder that made even the dignified waiter conceal a smile!

And now, at the table, both are embarrassed. He

is wondering whether he is expected to order for both, or allow her to order for herself. She is wondering which fork is for the salad, which for the meat. Both are trying to create conversation, but somehow everything they say seems dull, un-

They will no doubt be uncomfortable and ill at ease throughout the evening, for it is only absolute knowledge of what is right and what is torong that given calm dignity and poise. And they do not know. She finds herself wondering vaguely what she will my to him when they leave each other at her door-whether she should invite him to call again or whether he should make the suggestion; whether she should invite him into the house or not; whether she should thank him or he should thank her for a pleasant evening. And similar questions, all very embarrassing, are

The evening that could have been extremely happy, that could have been the beginning of a delightful friendship, is spoiled. He will probably breathe a sigh of relief when he leaves, and she will prob-

ably cry herself to sleep.

bothering him.

How Etiquette Gives Ease

Are you always at case among strangers, are you niways calm, dignified, well-poised no matter what happens, no matter where you chance to be? You can be-if you want to. And you should want to, for it will give you a new charm, a new power. You will be welcomed in every social circle, you will "mix" well at every gathering, you will develop a delightful personality.

By enabling you to know exactly what to do at the right time, what to say, write and wear under all circumstances, etiquette removes all element of doubt or unyou do it. There is no heartancy, no embarrassment, no humiliating blunders. People recognize in you a person of charm and polish, a person following correct forms and polite manners.

Every day in our contact with men and women little problems of conduct arise which the well-bred person knows how to solve. In the restaurant, at the hotel, on the train, at a dance-everywhere, every hour, little problems present themselves. Shall olives be taken with a fork or the



hall the invest him ton the house? Shall the 4th him e call against that the shock him for a pleasant vising? In earlie and engineers there guardens from the him him him of the humber causely wings to do over any at all several.

fingers, what shall the porter be tipped, how shall the woman register at the hotel, how shall a gentleman ask for a dancecountless questions of good conduct that reveal good manners.

Do you know everything regarding dinner etiquette, dance etiquette, etiquette at the wedding, the tea, the theatre, the garden party? Do you know how to word an invitation, how to acknowledge a gift, how to write a letter to a titled person? Do you know what to wear to the opera, to the formal dinner, to the masquerade ball, to the luncheon?

The Book of Etiquette

Complete in Two Volumes

In the famous two-volume set of the Book of Etiquette the subject of correct form for every occasion is covered completely, authoritatively. It is recognized as the most thorough and reliable book on the subject available today. It is encyclopedic in scope, answering every problem of etiquette that may be puzzling you in a clear, definite, interesting way. Nothing has been forgotten. Even the ancient origin of customs has been traced, and you are told exactly why rice is thrown after the bride, why black is the color of mourning, why a tea-cup is usually given to the engaged girl.

With the Book of Etiquette to refer to,

you need never make embarrassing blundern. You can know exactly what to do, say, write and wear at all times. You will be able to astonish your friends with your knowledge of what is right under all circumstances.

deed many at the table, both are embaronessed. Indeed, can there be now desponding groups; then their of and honorous man their of and honorous man their section property and being such of one a manuscraft first so entry for prophe to weathings and.

A great deal of your happiness depends upon your ability to make people like you. Someone once said, 'Good manners make good company," and this is very true. Etiquette will help you become a "good mixer"-will aid you in acquiring a charming personality that will attract people to you. Because you will rarely be emharrassed, people who associate with you will not feel embarrassed-your gentle poise and dignity will find in them an answering reflection and you should be admired and respected no matter where you are or in whose company you happen to be.

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will answer these and a score of other interesting questions about the muscular mechanism and evolutionary origins of laughter in the next issue of POPULAR SCIENCE MONTHLY

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Audiences laugh at his jokes because he has made a scientific study of laughter-he has learned what makes us laugh and why we often fail to laugh when it seems we should. He knows in advance how audiences will respond to the "laugh lines" in his monologues. He has mastered the secrets of his trade.

4-23

Tor many years Will Rogers-of. THe is going to reveal those secrets and other tremendously interesting things-learned during an unparalleled career on the stage and before the motion picture camerain an exclusive article in the next issue of POPULAR SCIENCE MONTHLY.

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In every man's life there is one Big Moment when he makes the decision that either robs him of success—or leads on to fortune

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AVE you ever considered why our richest men come from our poorest boys? Isn't it a strange thing that it is almost invariably a young fellow who starts life without a cent in the world, without education, without influential friends—in short, without one single solitary advantage—who accumulates millions of dollars? Isn't it a miracle that inside of a comparatively few years a man can rise from abject poverty to fabulous wealth?

The Secret That Makes Millionaires

Astonishing, certainly—but more important, it is wonderfully inspiring. For it means that no man need be held down by circumstances. Once he knows the "millionaire's secret," he can put it into operation regardless of all obstacles that seem to block his path. He suddenly finds that everything he touches turns to gold—money flows in upon him—fortune showers him with its favors. Everything he wants seems to come to him just as surely and easily as day comes after night.

What is this amazing secret that can work such wonders? It is just this: The thing behind all big achievement is Opportunity.

To every man there comes one BIG Opportunity—the golden chance of his life. And in the moment he decides for or against that opportunity -whether he will seize it or let it pass-he decides the whole future course of his life.

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This very minute you may be face to face with your BIG opportunity—your one chance to earn the biggest money of your life! Right now your decision may mean the difference between a life of plodding, routine work at low pay and a career of inspiring success and magnificent earnings.

For now you are offered the very opportunity that has made other men rich, that has brought them more money than they ever dreamed of earning.

It is the same opportunity that lifted Warren Hartle of Chicago out of a job in the railway mail service where in ten years he had never gotten beyond \$1,000 a year, and landed him in a \$10,000 a year job. It jumped Charles Berry of Winternet, Iowa, from \$60 a month as a farm hand, to \$1,000 a month, It brought to C. W. Campbell of Greensburg, Pa., a clerk on the railroad, a position that paid him \$1,562 in thirty days.

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Your Big Opportunity may be here too, in the wonder field of Salesmanship. Perhaps you say you have never even thought of becoming a Salesman. But before you decide
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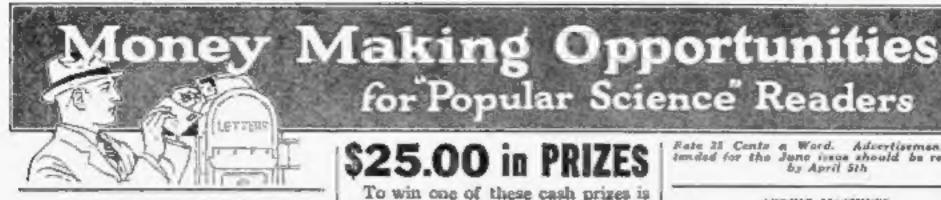
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Then write a short letter, not more than seventy words, teiling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. have a good chance of winning one of them. Be sure to mail us your answer before April lst. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prises will be printed in this column in the June Issue. Address your prize letter to-

Contact Editor

POPULAR SCIENCE MONTHLY 225 West 39th Street, New York City

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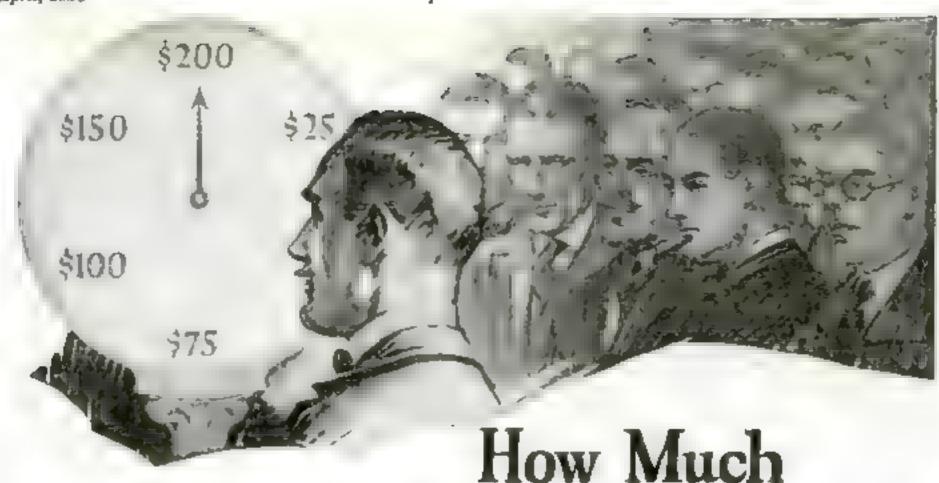
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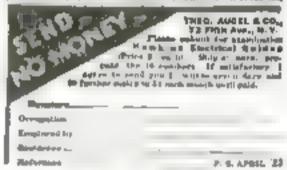
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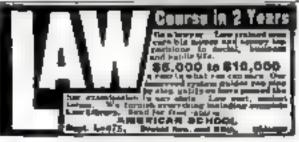
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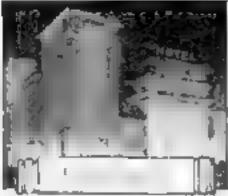
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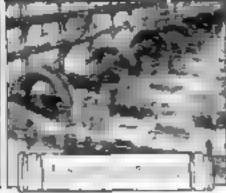


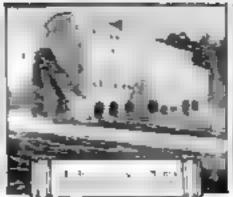














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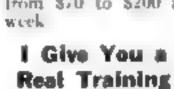
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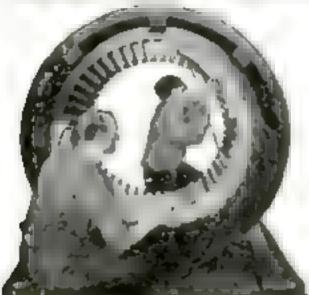
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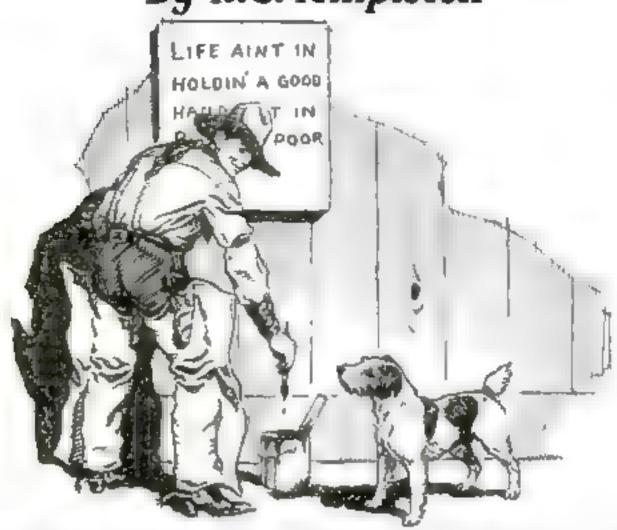
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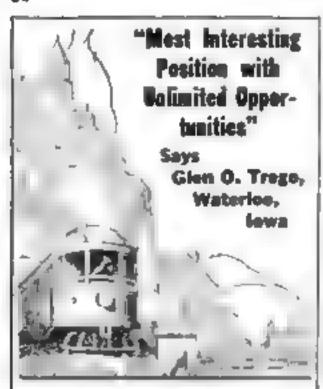
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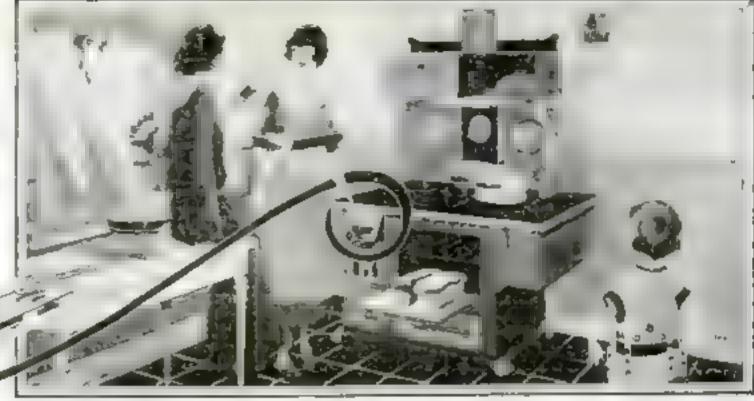
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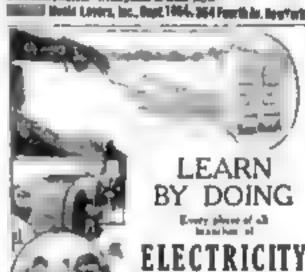
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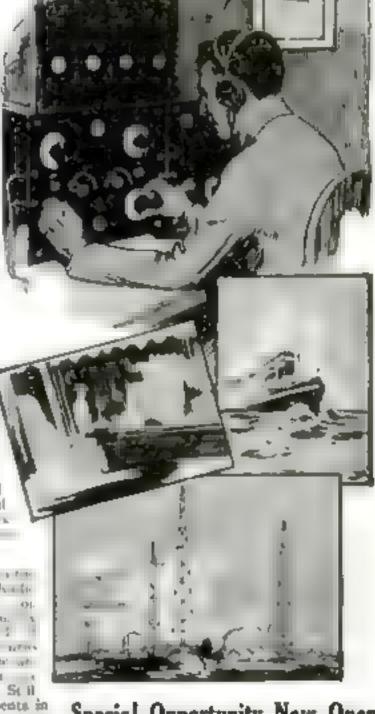
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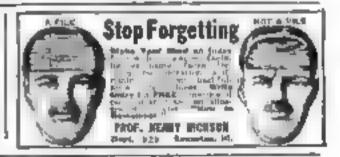
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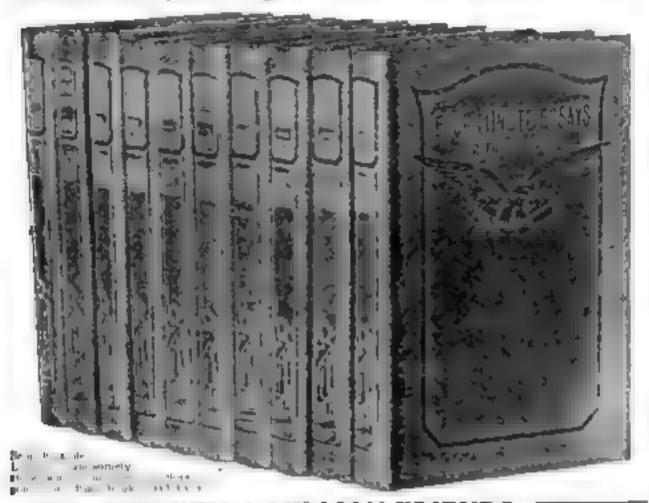
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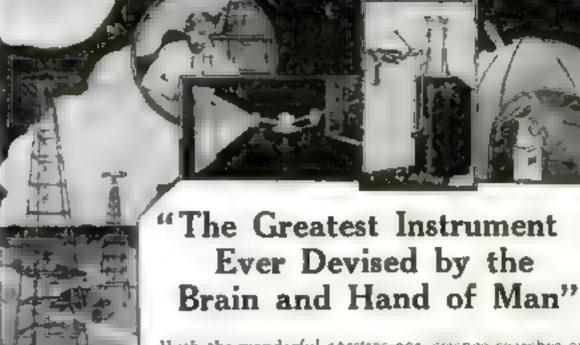
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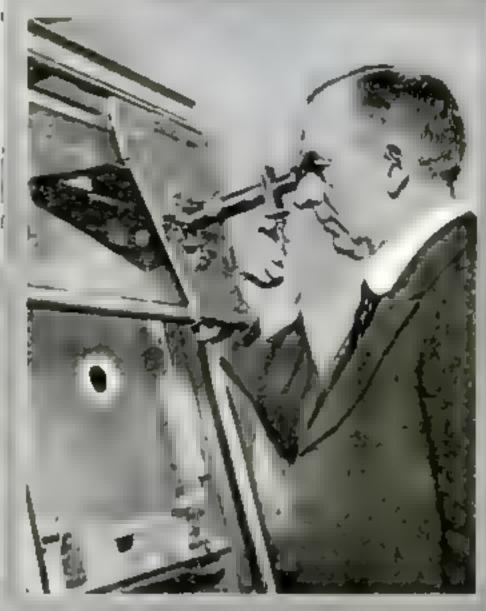
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Men of the Hour in Science and Discovery





Taiking across the Atlantic

Talking by radio from his office a New York

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To Broadcast Movies

ton, D C, inventor below, now proposes to broadcast movies by the same means. His project will be expected in our May issue.



Around the World in 60 Days!

BY FLYING around the world in 60 days, Alan Cobbam, most famous of British civilian sylators, proposes now to go Jules Verne one better.

Accompanied by Lieut.-Commander Mackensie Grieve, who was with Hawker in his attempted cross-Atlantic fight, and

fly ng a De Haviland machine driven by a 240-homepower Sidney-Puma engine, Cobham will girdle the globe by way of Central Europe, Constantinopie, Bagdad, India, China, Japan, the Aleutian Islands, Vancouver, Newfoundland, and the Atlantic.

"If any airmen can accomplish the feat," and a noted aviation authority recently, "Cobham can do it because he will leave nothing to chance" thereby explaining Cobham's success as at aviator.

Tests Einstein Theory

EXAMINING ten thousand photographic plates exposed during last examiner's expection to the Antipodes to enserve the renent origin, of the sun life W. W. Carribel derector of the line theory at rry Carlib and lines tens for the University of Carrier expects of prove or disjusted or or as ely the Emstern theory of real to

Science for Everybody

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POPULAR SCIENCE MONTHLY

APRIL, 1923



How Our Earth Was Formed

Will It Perish in Collision with Some Huge Wandering Star to Die in Flaming Dust as It Was Born?

The Story of Man and His World

By Dr. E. E. Free

A Fascinating Serial of Ecolution

This is the second of a fascinating series of articles on the secrets of life, prepared with the cooperation of some of the world's leading econtists.

TREMENDOUS
burst of light blazed
out in infinite space;
two huge stars
surged together at terrific
speed. They shattered vast
fragments from each other
as they passed—and thus our
earth was born!

No remance is more interenting, no chapter of science more inspiring, than the story of how modern astronomers have learned to read the meaning of the stars; of how they have gone exploring into the vast depths of space and come back with answers to some of the first questions that man ever asked himself, questions of what the stars are made of, why they shine, how far away they are

The First Science

Astronomy was the first octon of an car. Six thousand years ago, on the plains of Chalden, shepherds who watched by night under the cloudless desert sky learned to notice the stars, to understand their motions; thereby to tell the time or the points of the compass or to predict the coming seasons.

A little later the pricate became astronomers and from the tall towers of the Babylonian temples men watched each night to chart the movement of the planets, to make star maps and observe sclipses, to inquire, in all earnestness and honesty, whether they could learn to read of human destinces among the stars

But though the stars had been studied for 60 centuries, we knew, even 50 years ago, almost nothing about what they really were. We knew that they were glowing bodies of some kind.



We suspected that they were a good deal like our own sun. We knew that hey were very far off, but only for a scant dozen of the nearest ones did we have much idea of just here far.

Today we know apprmously more than this. We know what chemical elements exist in the stars and that they are the same elements that we have on carth. We know the outhe stars. We know how had then are that some are thousand if togrow he pr t is he app water them. are comer We know trat some stars are dwarfs even emulier than our run, while others are giants larger in lumeter than the entro othil of our earth. Three of three giant stars have netvally been weighed and

Two Star Streams

We know that down nature exist; two great globes, each arger than our par, revolving the the bats of a damb-bell around their new conter digravity. We also a gift a step are two great streams of them they risk to be a gift a step are two great streams of them of the address of the gift and gift a step are to the address of the gift and gift a step are the content of the address of the gift and gi

How Astronomers Read the Secrets of the Stars

NEARLY all that we know of the stars what they are made of how fast they travel, and how far away they are we have seamed by means of the spectroscope as that the spectroscope as that the spectroscope as that the spectroscope as the order

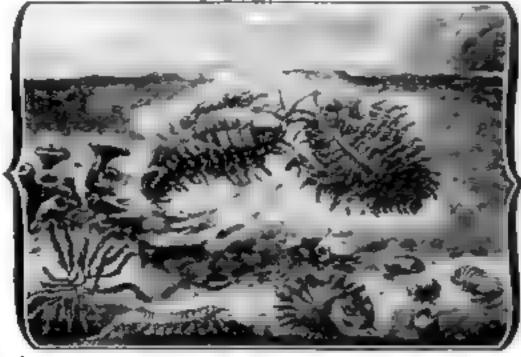
shown in the diagram above at right. The above illustration shows how the spectrum of a gamous tebula might look if it could be speed out on the floor. Running across the spectrum are a number of lines at original intervals. By these lines at original have learned to read what chemical chemical means are in the white hot clouds of

simpling gas that produce the light in this carance hydrogen between and nebulation. Nebularing a believed to be an element unknown on earth. Each element produces one or more lines.

The spectroscope also tells us whether a star is moving toward as or away from us, and how fast

Actors from the Drama of Life that Began about 1600 Million Years Ago

IN THE AGE OF THILDERTES 600 MILLION YEARS



A battle between trilabites, anomitors of our modern now bugs, which dominated the seas about 600 million years ago. Notice that it took life about a billion years to develop itself into this crude buglite animal

IN THE AGE OF FISHES 375 MILLION YEARS AGO



A gigantic teethed fish, the dominant form of life about 225 million years later than the ege of trilebites, as evidenced in the rock strate of Ohlo

IN THE AGE OF COAL 300 MILLION YEARS AGO



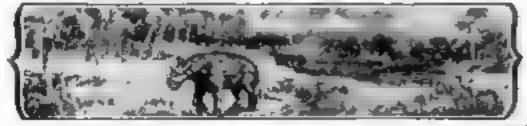
After about 75 million more years life had developed to the stage of these amphiblants—like creatures that could live either in air or in water

IN THE AGE OF REPTILES 75 MILLION YEARS AGO



This great horned reptile, Triceratops, from 20 to 25 feet long, lived about 225 million years later than the amphibians. Notice the sharp cutting beak

IN THE AGE OF MANMALS 40 MILLION YEARS AGO



Large hoofed Uintathers now estinct, and a small form of camel, typical of the ancient mammals that lived about 36 million years later than the great horned reptile, or about 40 million years before the advent of max

see. We even know something of the shape and size of the star cloud made up of these two atreams, the cloud that includes all the stars we see and which is, for us, the visible universe.

Most of this tremendous increase in scientific knowledge has been due to an entirely new method of investigation, to an instrument called the spectroscope, which analyses the light of the stars and tells us what particular kinds of glowing matter produced that light.

A Yardstick for the Heavens

Another use of the spectroscope is as a celestial yardstick. By its help we can measure how far away the stars are; whether a star is moving toward us or away from us, and how fast. Some of the star distances thus discovered are astonishing. Even the nearest star, one that is close enough to be measured by ordinary surveying methods without using the spectroscope at all, is 26 trillion miles from the earth. For the more distant stars—the ones measured recently by the newer methods—miles become altogether meaningless and satronomers use the light-year, which is the distance that light, moving at 186,000 miles a second, will travel in one year. The farthest stars yet measured are 220,000 of these light-years from us. The visible universe, the cloud of stars that we see and of which our sun is one, is believed to cover the automaking distance of at least 300,000 light-years from aide to side.

These figures simply demolish the human imagination. Think of the distance from us to the sun. For a man, that is a tremendous distance. An airplana flying night and day at 200 miles an hour would need a little over 52 years to make the trip. Yet this 52-year journey to the sun is only about one fourteen billionth of the distance to the farthest known star; about the same as the thickness of a sheet of paper in comparison with the distance from New York to San Francisco.

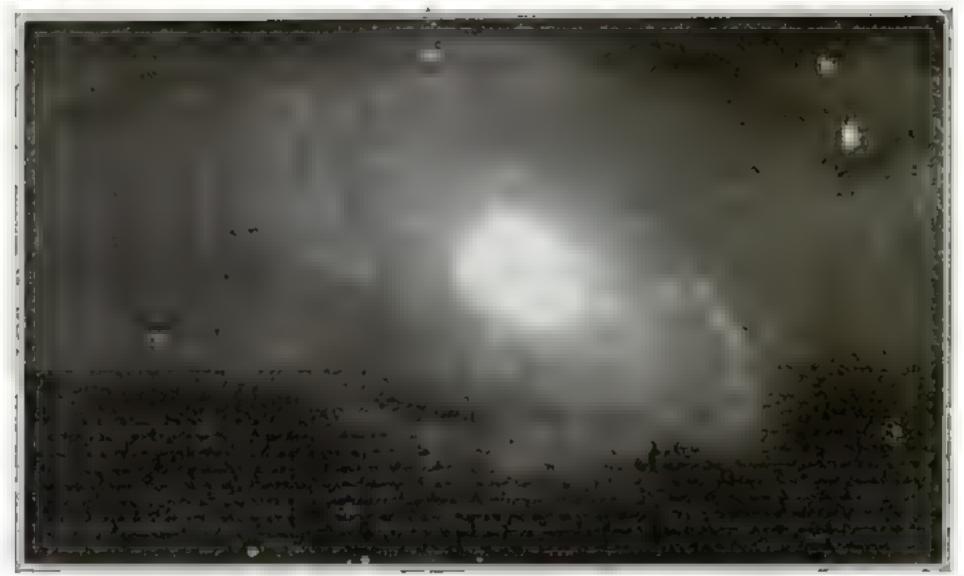
Two Billion Known Stars

And in this autonoming depth of space there are over two billion stars that we know about, one star for every man, woman and child now alive in the world, and enough stars left over so that averybody in the United States rould have three or four extra. Probably there are a vastly larger number of stars that we do not know about because they are too small or because they are dark and send no light to us. Hillions on by lions of stars, most of them larger than our sun; un one knows how many billions more of planets and earths and moons, of star clusters and of nebulae, all of them inside a space so vast that the nearest of them are trillions of miles apart—this is what we know of the universe.

And man, crawling around on his one small dust mote of an earth, has been able to stretch out the fingers of his mind through all this swarm of other worlds, has been able to weigh and measure and to understand

No fact in the universe, no achievement of man, is more truly wonderful than this. Now let us look back into time instead of out into space. How did this earth of ours, so tiny but so all-important to life, come to be formed?

The earth was core, we believe, a part of the mm. It was pulled out of the sun,



Here is the great spiral nabuta in Andromeda, a tramendous mass of whirling gases thousands of times larger than our whole solar system. This is perhaps one stage in the formation of a star

billions of years ago, by an encounter with a passing star

The sun is a star; one of the two billion old stars that we know. It is not fixed at a certain point in space. On the contrary, it is moving about 18 miles every second, carrying us and all the planets with it. The other stars move too. All of them drift about in space like flying grain in a great room.

When Drifting Suns Came Together

The sun has been drifting about in that way for a very long time. It was once larger than now, and hotter. It had no family of planets as it has today. It was merely an unencumbered single star drifting about similersly by itself

And then, one day, eight or ten belien years ago, another one of these drifting stars happened to come too close to our sun. Perhaps it came within a few billion miles; close enough, anyway, that the attraction of gravity between it and the sun grew to be dangerously large. This attraction pulled out of the half-fluid sun

a lot of drope of matter, much as the gravity of the earth will pull drope of water out of a wetted sponge if you hold it up.

The other star moved on It left behind a somewhat damaged sun; a sun sur-rounded by a great revolv-

ing cloud of lumps of matter that had been pulled out of it. Gradually these lumps gathered into larger lumps. These are the planets. The earth is one of them.

This is the modern idea of how the earth was formed. Our globe grew, you perceive, gradually, lump by lump, as the bits of matter that had been pulled out from the sun were picked up. Already six billion or eight billion years ago the earth had grown to about its present shape and size

It is reasonably certain that the earth at first was very hot, hot enough to be moiten all the way through. Its surface was a sea of melted rock in which great flaming tides hundreds of feet high raced twice daily around the globe. Gradually the rock grew cooler. It hardened After awhile there was a solid surface crust. And slowly, after many millions of years, this crust grew cool enough for water to rollect in hollows on it and to stay there. The first occass were formed.

Then ended the astronomical part of earth history; then the geological part began. With the first seas and what went on in them we come to the part of the story of the world that we can read in the record of the rocks

The rocks under our feet, the rocks that make up the accessible crust of the earth, are in separate layers, piled one on top of each other like a pile of blankets in a store Geologists call these layers strats

Earthquakes and volcanic eruptions, other convulsions of the earth, have twisted and torn these strata. Layers that were once deep down in the earth have been tilted up so that they are exposed on the surface where geologists ern

get at them for study. And so, gradually, we have learned a good deal about what they are, about which layers are on top and which underneath, all over the earth.

We have learned, too, how these rock layers were made. There is no doubt that they were formed in water: that most of them were produced in about the same way that rocks are still being formed on the bottom of the ocean close to the shore

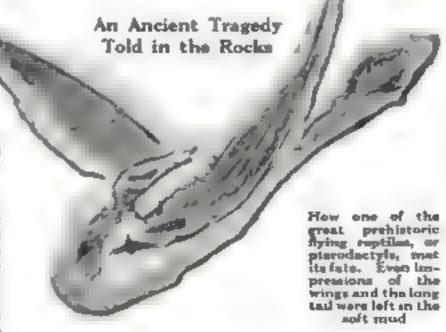
by the slow hardening of loose sands and clays carried down by rivers into the sea.

How Earth Strata Were Formed

Very few rivors are entirely clear. There is always a little andiment, as you can prove for yourself by allowing a little of the water of the Mississippi, for example, to stand a day or so in a glass. This aediment goes out to sea with the water. More sediment, the sandier part of it, washes out along the bottom of the river. All of it, when it gets to the sea, falls to the bottom. There it gradually hardens. It is alowly changed into rock, into sandstone or state or, with the addition of observably formed lime, into limestone.

Now and then a fish dies and its bones mak to the bottom. Occasionally a shellfish or a tree trunk or the bones of some land animal, wash out and are buried by the mud. These make the foss is. Millions of years later the feasils and the sedment together, raned above the sea by some movement of the earth's crust, will make a rock layer for future geologusta to study

Thus were formed the strata of the earth. Some times rock was formed near the shore, so that we can see in it the footprints of some great reptile that ventured





So staggering are the sizes in our solar system that even the planet Jupiter, beside which our earth is a pygray, is less than one thousandth the size of the sun

out one day, millions of years ago, onto a muddy beach while the tide was low, Bometimes we find layers of coal where the rank vegetation of some seashure marsh gathered for ages and was buried. Altogether there are at least 55 miles of strata, for that is about the total thickness of the rock layers that geologists have identified and mapped.

How much time does this involve? How long did it take for these 55 miles of rock to accumulate, sand grain on sand grain, in the sea?

Until very recently geologists were not sure. The rate at which the sediment accumulates is irregular It depends on the speed of the rivers from year to year and age to age. The uge of rocks in years cannot be determined merely from how deep they lie in the pile of strata.

The problem seemed to be insoluble until

the discovery of radium gave us the key to the pussle.

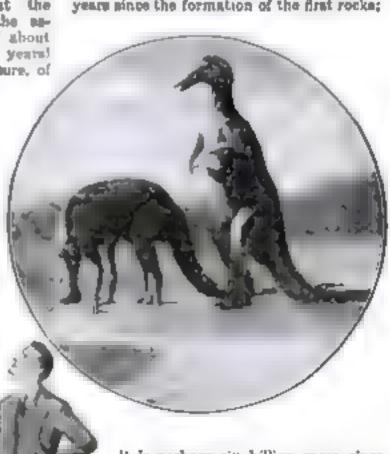
is that its atoms are explosive. A certain percentage of them explodes every minute. They leave behind them certain other elements, especially lead. Accordingly, if you find some radium in a rock, or, better still, if you find some of another elementuranium—the atoms of which explode more slowly, and if you also find some lead, you can conclude that the lead has been formed from the radium or from the uranium. Determine the exact amounts of uranium and of lead and you can calculate how long this has been going on-that is, how long it has been since that rock was formed.

This has now been done for many samples of rock from all of the various rock layers. We have learned tho ages of all the different strata in the pile. The oldest once, at the bottom, have the satounding age of about 1,600,000,000 years! We are not sure, of

course, that they are exactly 1,600.000,000 years old. The radium clock is not quite so accurate as that. But we are sure that It was a very long time; a time to be measured, at the very least, in hundreds of millions of years.

And even this immense age is only the age of the oldest rocks. The earth [taelf is far older. Before rocks could be formed at all, the primeral earth had to finish its growth, had to become cool enough to hold a liquid sea, had to shrink enough to form ocean basing and thus to rame land above the waters.

How many billions of years it took for the earth to get this far in its development. no one knows It is almost two bill on years since the formation of the first rocks;

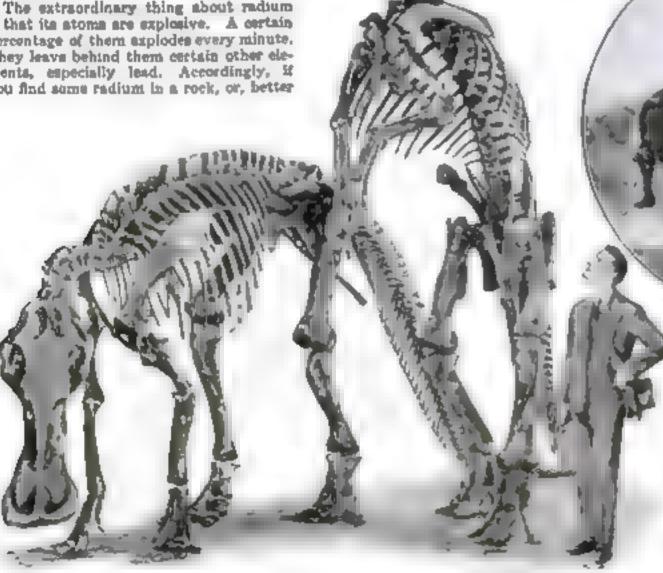


it is perhaps six billion more since the birth of the world. Who knows how many more billions for the previous history of the sun?

This is our estonishing vists of the past. Quite as incomprehensible, it is, as the quintillion miles of known space. In comparison with even two billion years, the whole history of America since Columbus is no longer than eight minutes out of a human ldetimel

So much for our sista backward. Can me look forward too? Can science return at last to the ancient effort of the first astrologers and learn to read the

(Continued on page 120)



Two reconstructed skeletons of gigantic plant-eating discounts of the Age of Rep-tiles, as they now stand in the American Museum of Natural History, New York. The smaller picture shows them as it is believed they appeared in life

Inventor Promises Disk Record Movie Shows for the Home

Film Projector Runs like a Talking Machine

THAT Edison did with the talking machine; what Bell did with the telephone; what Ford did with the automobile, C. Francia Jenicias, inyeztar, of Washington, D. C., now pro-

poses to do with the movies By means of an ingenious prism projecto-

apparatus, growing out of his study of prismatics—a study by which, incidentally. Jenkins worked out the principle of radio transmusion of photographs, to be described in the next lesus of Porturat Source Monthly—the Washington in-

machine that, be declares, will put movies in the home, along with the making mashine, the telephone, and radio, and at a cost within the average man's pecket-

For some time leadors in the motion ploture industry have believed that the greatest future use of movies would be in the home. But to meet the requirements of this field, it was necessary to devise a projectthe muchine as easily

managed as a talking machine, with "records" just as simple in form. This, Jenkins believes he has done. With his duk record apparatus he hopes to make available to stay-at-homes the greatest motion parture productions.

In countraction, the new home movie machine is surprisingly simple. To operate the phonograph-like dak containing the movie film, a mechanism like that of the modern enbinet phonograph is used The ministure movie is projected on the Inside of the hinged enbinet cover

One of the first problems encountered was that of devising a small, compact disk that would hold the thousands of pictures necessary for one reel of movies. This, Jankina accomplished in a truly ingenious way First, the opening pictures of a reel were posted in order around the rim of a paper disk about the size of a large disk

11111 TO STATE OF ventor has perfected a "movie record"

Note how the paper disks

that have been run off

are bent up over a guide

frame to expose the succooding pictures to the

projection priema

How the Invanior, ra noi Jankine, Jankine, converted talking machine into a disk record movie projecter. By an ingenlaus acrangement of prisms and oscillating mirror, pictures attached in requeston topoper disks, left, are projected movies on the cabinet

record. Naturally, one disk accommodated comparatively few pictures. So Jonkins arranged the succeeding pictures of the reel on other similar disks, which he placed in order beneath the first one

By means of a radial slit, each deak in the series slightly overlapped the one beneath it, so that when the pile of disks was rotated, with a guide wheel running between the layers of paper, the effect was to produce a continuous apiral strip of paper and pictures. This arrangement, somewhat like a sparal spring, thus produced a continuous sequence of pictures. As the disks were tun off, the thumblike frame of the guide wheel bent back the med disks so as to expose the succeeding pic-

Then the problem was to provide a means of prosection, including an intermittent mechanum to produce for the unuided eye the effect of one continuous moving picture on the screen. Thu, Jenkins was able to solve through his knowledge of prismatics. On each side of the image he desired to project, Jenkins placed a prism that caught the light and threw it on the picture. From the preture the light passed upward through a lens to two oscillating murrors, which is turn projected it on the screen.

A trief of the disk movie machine simply turns on the electric current that drives the small motor, places on the retatable table his disk "record" that contains the "reel" of the film, switches on the projector light, then sits back to enjoy the show. The thumblike gulde wheel arrangement follows down the spiral formed by the overlapping disks; the oscillating mirrors pick up the in ages thrown upward by the prism arrangement, and the moving pictures are projected in miniature.

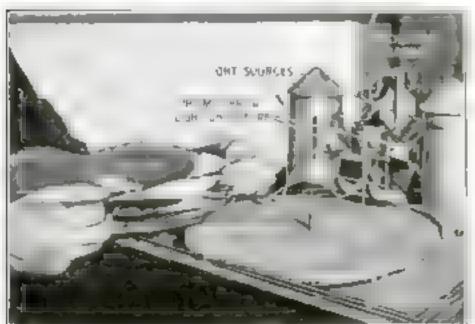
Why America Uses More Dope than China

WHAT are the facts about habit-forming drops and the fas-emation they hold for their shortlived addicts?

Just now Americans are facing the autounding fact that in this country last year there was a consumption of 36 grams per capita of habitforming druge; that we used 40 times as much of these soul-wrecking chemicals as China, and that consumption is growing, rather than decreasing, at an alerming rate.

Where do these drugs come from? How are they prepared? Why will people steal and slay to get them? What are the physiological and moral effects of these drugs?

There are some of the questions that will be assumed in the May HERE OF POPULAR SCIENCE MONTHLY The drug problem is the most vital America has faced mince prohibition.



Complete apparetus for producing disk movies. Note that the paper disks are hold spart to show how each disk overlaps the one below it, giving the effect of a continuous circular strip

Can We See with Our Noses

Amazing Feats of 17-Year-Old Blind and Deaf Girl, Who Smells Colors and Feels Sound, Convince Scientists that Unused Powers Lie Asleep in Our Senses

"AN we learn to see with our poses? Can we warn to hear with our finger tipa? Can we develop eyes in the backs of our heads or wherever else we happen to need them?

The amazing case of Willetta Huggins, the 17-year-old band and deaf girl of Janesville, Wis., makes these questions much less funtuatic than they would have seemed a year ago. For Willetta can do some of these

things.

While we human beings have been developing to a high degree nur senses of eight and hearing, have we failed to develop at the same rate our senses of smell and touch? The accomplishments of this little girl, handicapped from babyhood, seem to prove that this is so,

She Smells Color!

Willetta can recognise colore by their smell. She can hear apoken words by placing the sensitive tipe of her Sugara against the throat of the speaker. Bhe can identify different people by their personal odore. She knowe, even, when the family eat enters the room for a moment and then leaves.

Physleians and psychologists are still debating the exact nature and extent of Willetta's powers. Scientific tests of her case are still in progress. There seems little doubt, however, from the experiments made that she really does possess a remarkable development of the sensor of smell and of touch.

When she was nine years old, Willetta was left an orphan. A year later she was admitted to the Wisconsin School for the Blind at Janesville, She was then partly blind and pearly deaf Within five years she had lost what remained of her hearing and a year later she became totally blind

Under this double misfortune she grow, as was natural, somewhat morose and listless. For a time she showed little interest in anything. Suddenly this changed. She was introduced by her teachers to Helen Keller's method of "hearing" by feeling

Her Interest Is Awakened

Almost overnight Willetta lost her listlessness and haufference. She not only found out that she could use the method made formous by Mass Keller, but she discovered a better method. She found that when she placed the tips of her fingers on the threat of a person who was speaking. she could "feel" what was said merely by the vibrations of the throat. It was not necessary for her to touch the lips at all.

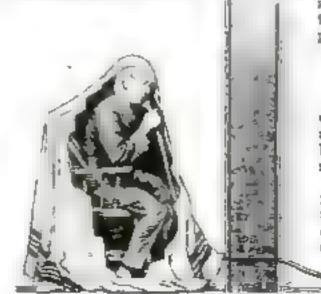
This unusual ability and the rapidity



Willetta Huggins, deaf and blind, hears the world of voices by plucing her Engers on the receiver disphragm of a telephone instrument. It is possible, scientists believe, that Willetta differs from the rest of us only in that she has learned been to use senses that we have neglected

with which she learned the use of it, attracted the attention of her teachers and tion. It was found that her sense of smell was no less extraordinary. The fame of

of the medical men attached to the instituher accomplishments spread. Attention



To demonstrate that persons with normal night and bearing can develop the sense of touch so as to distinguish sounds with their hands, two students

Through her consilive finger t.ps. this remarkable 17-year-old deafbl rid gizî feela words as they vibrate down a long pole resting on the head of the speaker

was attracted in Chicago as d on April 26, 1922, W lletta was examined before the Chicago Medical Sucrety

There is still some controversy about exactly what she can do, but the following facts are well a tested

She can recognize apoken sounds when her fingers are tourhing the throat of the spender. She investe that the does not hear the sounds. She mayn that she "feels" them. She can also [see] sounds in the party way through a worker rue much as a larger of a sage of a sag which is pressed against the chest of the specier the other end of which she

She carries around with her a portable telephone of the kind used by deaf people, but she does not put it to her ear. Instead, she touches the vibrating disphragm in the

telephone with the tips of her fingers. She asserts that she feels the vibrations of sound in this way. She has been able, under test, to bear concerts and stage performances and to describe correctly what was happening. Aided by her telephonic apparatus, she can carry on a conversation with all the case of a person who has perfect hearing.

Feels the Ink on Newspapers

She can read newspaper headlines, the denominations of paper money, and similar matter printed in large type merely by running her flugers over it. She says she feels the ink on the paper.

There is little doubt, also, that she can really smell colors. In a series of careful tests arranged by Dr. Thomas J. Wi liams, of Chicago, and Professor Robert H Gault, of the Department of Psychology of

at Northwestern University conducted this speaking tube test under the direc-tion of Professor Guult, noted psychologist. With spee and ears handaged, and

And Hear with Our Fingers?

Northwestern University, Willetta a eyes were thoroughly blindfolded by a pair of black goggles stuffed and covered with cotton and fastened down to her forehead by adhesive tape. She named correctly the cotors of 30 samples of yern as well as many other colored objects. This was

done even without touching the yerns, merely by smelling them when they were held close to the end of a glass tube about four inches long

What Skeptics Say

The doctors who disbelieve in the reality of Willetts's powers explain these accomplinhments as due to unconscious deception on her part, The girl's eyes and ears do not show any perceptible injury. If she is ready bitnd and deaf, it is because of some trouble in her brain or in the nerves wading to it, not in the eye or car themselves. The skeptics point to this fact. They say that she is not really deaf nor blind at all; that abe merely thinks she is and thinks it so Intensely that for all practical purposes she really

This would be quite possible. Such cases are common enough in the records of psychology,

cannot see or hear

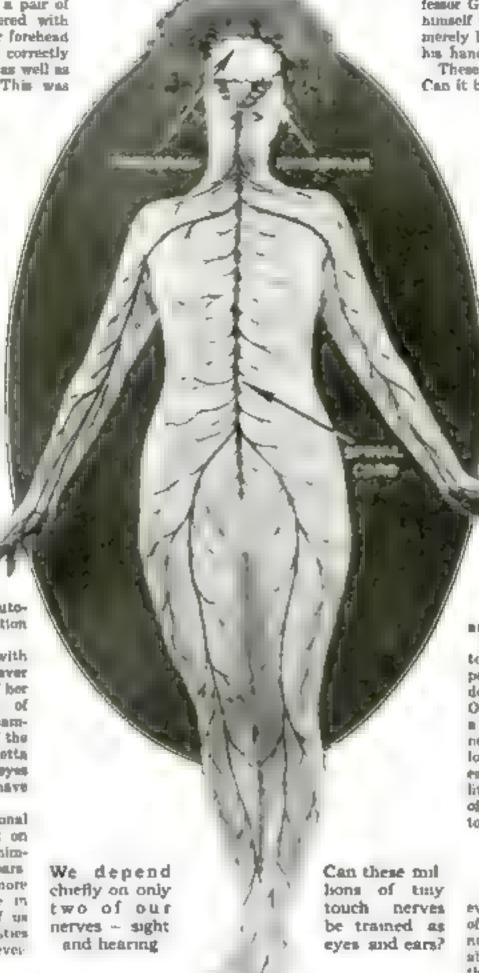
They are instances of extreme autosuggestion; harmful autosuggestion instead of the curative variety.

But that this is the case with Wiletta seems doubtful. Whatever may be the real explanation of ber marvelous powers, any kind of shamming, even unconscious shamming, seems to have been out of the question in the tests when Willetta was bindfolded. Even if her eyes had been normal, she could not have seen the colored yarns.

Then there are some additional experiments of Professor Gault on normal people, people with unimpaired equipment of eyes and ears. These experiments are even more sign ficant than Willetta a case in supporting the idea that all of us

may have unsuspected possibilities of sense development.
Among his students Pro-

with one hand over the tube, the student at the right distinguished words spoken into the tube by a second student covered by a heavy blanket 30 feet away



A Million Unused Eyes and Ears

fessor Gault has discovered two persons who have the beginnings of Willetta's ability to smell colors. They can distinguish by smell alone whether two samples of colored yarn are slike or different. They are not able, as yet, to name each of the colors as Willetta does, but it is reasonable to believe that they possess the same power, the only difference being that they have not been forced to develop these powers of their other senses.

Professor Gault is testing, also, the possibility that normal persons can learn to feel sound in the same way as Willetta does. By means of the speaking-tube apparatus illustrated below, one of Profemor Gault's students has already taught hunself to distinguish five different words merely by the feel of them on the pairs of his hand

These results are sufficiently startling Can it be possible, one sake, that Willetta

Huggins differs from the rest of us only in that she happens to know how to use senses that all of us possess but have neglected?

Heliteresery

Hote Earthtoorms See

The biologist is inclined to say that it is quite possible. The common earthworm, for instance, has only one kind of nerves. His only sense, apparently, is the sense of touch, He has no eyes nor ears nor any sort of organ corresponding to our nose. Yet the earthworzn can see, and will withdraw quickly into his burrow if you turn a light on him. He can hear perfectly the noise you make when you stamp your foot on the ground. He can smell his favorite foods

some little distance away and he pover makes a mutake about them.

Evidently the touch nerves in his body perform for him the functions of all the kinds of nerves, they are his eyes, his ears,

and his nose.

In the course of evolution, these touch nerves of the earthworm, competent for any kind of duty, have developed into our special senses. Our eye, for instance, originated as a part of a sensitive plate of touch nerves on the heads of some of the lowest backboned animals. Our ear seems to have grown out of some little harrike organs on the heads of fishes; organs used, apparently, to detect vibrations in the water

Nerve Powers Long Unused

And it may be that our nerves even after all these millions of years of training for some special job, have not forgotten that they used to be able to do all the jobs, that one and the same nerve was once the carrier of messages relative to all five of our present senses.

This seems to be the biological lesson of the case of Willetta Huggins. It seems to follow, even more clearly, from the experiments of

Professor Gault. And further evidence comes from Professor Long Farigoule in France, who reported some months ago that he had been able to train certain men among a group of blinded soldiers so that they could perceive light by their finger tips.

It is possible that we stand on the threshold of amazing and revolutionary discoveries concerning our senses. We may be able not only to better the lot of those unfortunates who are blind or deaf, but to reduced in ourselves capacities of smell and touch, perhaps of other senses which we do not dream we possess

Noted Scientists Grapple with Food and Fuel Famine

Search for Secret Process by which Plants Harness Enormous Energy of Sunlight

By Thomas Elway

HE coal and oil supply of the world is rapidly being used up.
What shall we do when it is gone?
Practical men have been asking themselves that question for a decade, and now the scientists of America have decided to answer it. They realize that a solution must be found, or civilization will perish.

At a recent meeting in Boston, the American Association for the Advancement of Science authorized its general secretary, Dr. D. T. MacDougal, to organise a cooperative scientific committee for the investigation and, if possible, the duplication of the process called "photosynthesis." This is the process by which green plants make sugar out of sunlight and water and the gases of the air.

Plants Supply Our Food and Fuel

This is the only source of food and fuel in the world. Our food is either itself of vegetable origin or is derived from animals that have fed on plants.

Fuel, of course, is a product of plant life, too. Coal, for instance, is merely the remains of plants that lived militons of years ago, using sunlight to make food and to grow, just as modern plants do. Oil likewise is the product of buried organic matter.

There are, it is true, a few other sources of energy. Most of these also depend on the sun, though some of them do so indirectly. An instance is water power. The heat of the sun evaporates water from the ocean. This water goes into the clouds and later falls as rain. It gathers into atreams and lakes and rivers and finds its way back to the sea. It turns our water wheels and turbines as it goes.

Windmills and wave motors are other instances of using solar energy indirectly. Back of them all is the sun, the original energy that lifts the water out of the ocean, that keeps the winds moving, that starts the waves.

Coal and Oil Supply Is Limited

But these indirect sources of energy are not really of much importance at present Nearly all the energy we use in the world—all our heat and power and artificial light—we get from coul or oil. And these, we must remember, represent our capital, not our income. They were accumulated during millions of years. When we have spent all of them, there will be no more.

The exhaustion of gasoline already is in sight. When it is gone, shall we have to atop using automobiles or can we find other

Scientists believe, of course, that we can find some other fuel, and there is much talk of alcohol. But alcohol can be made only from vegetable matter. To use starch or sugar for this purpose would decrease the world's food supply. Then there is the difficulty, to which we shall refer later, of the distillation of alcohol.

It is conceivable that ways will be found to tap totally new supplies of energy not



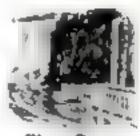
How We Use Sun Power



From an inventory prepared for the American Association for the Advancement of Science by Dr Edwin E Signon, famous scientist



Oll and coal are the stored-up energy of the sun, accumulated millions of years ago by plants that used surlight for food and growth just as modern plants do



The power of Niegare also comes from the sun, for it is solar heat that lifts out of the ocean the water that makes the rain and forms rivers

Water Power

New Ways to Use Sun Power



Can Solar Energy be used directly? Giant concave mirrors may be employed to concentrate the sun's best on special types of water boders



Wind Motor

Wind motors, to harness the winds created by the sun a heat, offer another possibility. It is grovement of the old fushioned windmill is interesting modern engineers.

A eyatem of locks

creating scashore

ponds to store the

water power of the

tides is still another

frequent suggestion

Even wave motors

are really sun mo-



Tide Arrester



tors to harness the power of the waver for it is the sun's heat that makes the winds and keeps the waves moving



For 13 years Dr. Herman A. Spoehr, distinguished chemist of the Carnegle Institution, has been trying to discover the process by which green plants make sugar out of sunlight, water, and the gases of the sir

related to the sun. There is, for instance, the energy of the atom. Radium gives out about as much energy as \$50,000 times its weight of coal. The only trouble is that we have no way of getting at this atomic energy or controlling it. No one knows whether we ever will have. The same is true of other non-solar sources, such as the internal heat of the earth or the energy of its rotation or the attraction of the moon.

Energy Income from the Sun

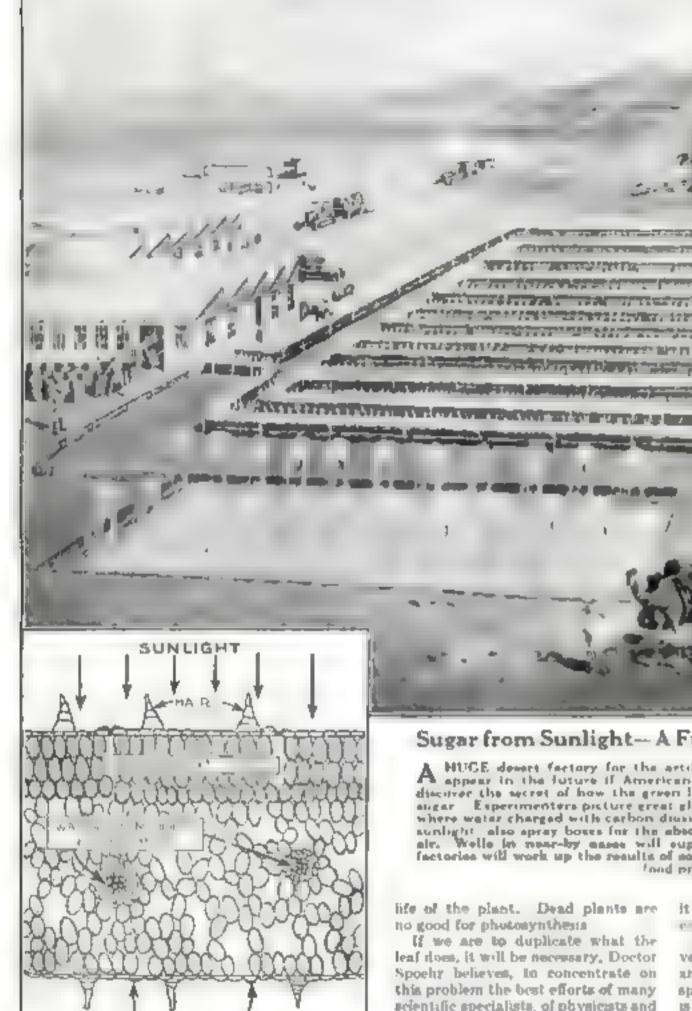
As practical business men facing a prospective shortage of our energy capital, would it not be prudent for us to stop counting on the uncertain prospect of atomic energy and find out whether we can make better use of the energy income that we now receive? This is the task set for Doctor MacDougal's committee of scientists.

Few people realise how tremendous this am energy income is. Even efter making deductions for the heat absorbed by the air and for cloudy wanther and the like, the energy received from the sun each day equals well over 20 tons of coal an acre of the earth's surface. For the whole United Stetes this amounts to an income of some 40 billion tons of coal a day, nearly 50 times as much energy as we use in a whole year!

The only way in which we now make use of this great energy income of ours in hy means of the work of plants—by photosynthesis. Inside of each green less are a lot of little granules containing a green substance called chlorophyl. This substance absorbs sunlight. It also takes up earbon dioxid gas, the same gas that is in sods water, traces of which are a, ways present in the air. From carbon dioxid and water, plus sunlight, the green chlorophyl makes sugar. The sugar feeds the plant. Utilisately it feeds the entireds

Searching for Plant Secrets

Unfortunately, the exact way in which chlorophyl puts water and carbon dioxid together to make augar is unknown. At the meeting of the scientists in Boston, Dr. Herman A. Spoehr, of the Carnegie Institution, described researches that have



This cross section of a green leaf, highly magnified, shows how a living plant absorbs aunlight, water from its roots and carbon process is one that may be duplicated for the proposed desert food factories

CARBON D OXID

MHALED YERE

kept him busy for 13 years in an effort to find out just how photosynthesis works. Carbon dioxid and water do not combine to make sugar when you merely mix them. Doctor Spoehr has not succeeded in persunding them to do so by any of the thousands of experiments he has tried.

It is certain, Doctor Speeks thinks, that what goes on in the green plant is not a simple chemical reaction, easy to duplicate. It is very complicated. It involves several distinct chemical reactions going on side by side; and at least one of these reactions in related closely to the actual

Sugar from Sunlight— A Future Desert Food Factory

HUGE desert fectory for the artificial production of sugar, as it may appear in the future if American supported succeed in their efforts to discurse the secret of how the green leaves of plants use surget to make sugar. Esperimenters picture great plans pipes laid in purrar lived troughs, where water charged with carbon dissid can be expired to the blazing desert surlight also apray boses for the absorption of the earbon decard from the air. Wells in near-by eases will supply the necessary water. Adjoining factories will work up the results of solar action into adible sugar and other fond pr ducts

scientific specialists, of physicists and thoograps of experts in familiat energy and of chemests. That is why the official committee of the American Association was author-

The scientists who undertake this investigation will have the task not only of doing at least as well as the plant does. They will have to do far better, for the work of the plant is

extremely inefficient. Of the tremendous amount of notar energy that falls each day on the earth's surface, plants use only the tiniest fraction, probably not more than one thousandth of it, even in the tropics, where the growth of vegetation is at its best. Any process for the artificial making of sugar by sunlight must show a far higher efficiency than this or it will never be really usterful.

Scientists are confident that this will be possible. Chemistry has bettered Nature's processes often before. Indigo, for example, was formerly a plant product. Now

it is made better and more cheaply in the processing furthers

It say we were impossible that before very many years we shall see factories for artificial food, as pictured on this page, springing up in desert areas where sunlight is unusually strong

But these factories will be sugar factorte enly they will not make motor (sel for us. It is true that the sugar might be made into alcohol, but the only way to do this is by means of yeast, and yeast has to work in water. How are we to separate the alcohol from the water?

This is done ordinarily by distillation, but distillation requires more best than the fuel value of the alcohol you producea fact frequently (orgotten by the persons who theorize about the possibilities of alcohol for fuel.

Probably a better solution will be some way of using the sun's heat directly for distribution, or perhaps a method of making alcohol or some other combustible liquid out of sugar by a dry process, without using yeast at all

How these problems will be solved, only time can tell. In any event, the work of the committee appointed in Boston holds as much interest for the general public as it does for the professional scientists.

An Amazing Night Photo—Rivaling the Stars

HIS extraordinary nighttime photograph of the Los Angeles district of California, taken from the alope of Mount W laon, illustrates two recent and striking achievements of science.

First, it marks the perfection of a photographic plate that will facthfully record the twinkling of millions of electric lights, like so many stars, in a panoramic view embrac-

ing a territory 40 miles square

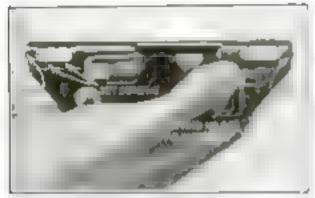
And, second, it illustrates the extreme sensitiveness of a reflecting galvanometer by which Dr. C. G. Abhott of the Smithsonian institution and other scientists at the Mount Wilson Observatory have succeeded at last in measuring the feeble beat sent to earth by distant stars. Detecting a hundred millionth degree of temperature and a triblenth of an ampere of electric current, this marvelow matrument is matantly disturbed, Doctor Abbott tells us, when any one of the countless city lights shown In the view on this page and page 35 is nwitched only

Working with the 100-meh telescope at Mount Wilson Observatory, Doctor Abbott and his colleagues have found that the sun's heat on 20 square feet equals one horsepower. The heat of all the stars equals 250,000 horsepower.



Taken from the slepe of Mount Wilson, in the foreground, this remarkable nighttime photograph of the Lee Angeles district. Calif , includes the lights of homes, streets, boulevards, and automobiles in a dosen cities and towns

Pin Gage Measures Diameters of Holes



Turning a thumbnut tests hole

AN ADJUSTABLE limit, pin produc-tion gage for measuring internal diameters, combining a "go" and "no go" gage, consists of a trusped casting with a movable pin at each end. One pin is locked according to the dimensions of the hole to be tested. The other, controlled by a thumbhul, slides in and out a distance that represents the inside and outside limits allowed.

The gage is placed in the hole to be measured and the thumbnut turned to determine whether the diameter comes within the "go" and "no go" limits.

Rotary Broom Sweeps Railway Tracks

TO KEEP dirt and trash from the rails a primary necessity for proper working of signals and for inspection of rail bondings -the Pennsylvania Railroad has developed a labor saving track sweeper for use in mountain sections

The aweeper corfuts of a rotary steel broom three feet la d ameter. In materi henesth on old flat the on special hangers that allow it to be raised or lowered at will The broom turns at anout 100 and is chain driven from a gasoline engine on the deck. A steel pan receives the sweepings from the broom and deposits them on a belt conveyor, which carries them to a hopper from which the dirt can be dropped at any convenient lo-



removed



Police Carry Small Tear Gas "Riot Guns"

A designed for use in quelling riots, has SMALL tear gas dispersing apparatus, receptly been adopted as part of the equipment of the Washington, D. C., police,

It commute of two turks, one for compressed air and the other for the liquid that upon release forms the tear gas. The compressed air is permitted to escape through a norsie, carrying a small amount of the tear gas with it. This forms a fine mut that causes any one who comes in contact with it to weep profusely.

Do Fat People Die Early?

/OU have often boord that excen-Y mon fat abortem a person's life. In this a sesentific fact? And if so, why? The truth about surplus flesh and its effect on the machinery of the human body will be told in next month's muc by Dr Eugene Lyman Fult, medical director of the Life Extension Institute.

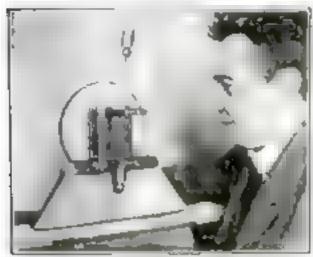
Los Angeles Hampers Astronomers 20 Miles Away



Immediately at the foot of the mountain is Passdena, while the long patch of brilliant lights in the distance is Los Angeles. At the top slong the coast are six beach towns

Thin threads of light joining cities are from automobiles on boulevards, while streaks of light in the sky at the right are the roving beams of a searchlight

Tickless Clock Eliminates Noisy Escapement



Rear view of the silent, tickless clock, showing balanced pendulum

A TICKLESS clock that may aventually replace the present type of timepiece with its noisy anchor and escapement regulators, has been perfected recently by a German engineer, Heinrich Schieferstein.

The invention is the result of study of oscillatory power as obtained from the motion of a pendulum, converted into rotary motion by transmission through a series of springs and wheels. The turning of the hands of the clock is accomplished by a weight that operates a gear wheel. Before this wheel can turn the hands, it must overcome the resistance of a smaller wheel geared to it and connected with the swinging pendulum by a connecting rod binged to the smaller wheel and featened to the pendulum.

As the power transmitted by the weight to the pendulum is constant, as in the length of the pendulum, the time consumed in one to-and-fro movement of the pendulum remains always the same. Therefore, the crank on the amaller sprocket is allowed to turn regularly by the pull of the weight and the regulating action of the pendulum and the hand wheel turns around at a definite rate, moving the hand through the space of a minute on the dial in exactly a minute's time.

Figures Show Amazing Radio Growth

THE marvelous increase in the use of radio in the United States was strikingly revealed in a recent announcement from the Federal Bureau of Navigation that the number of broadcasting stations jumped from three in October, 1921, to 564 in November, 1922. Amateur stations during the same period in-

creased from 11,000 to 18,465. Receiving stations throughout the country are numbered at 1,000,000.

In making this report, David B. Carson, commissioner of navigation, advocated constant supervision of broadcasting to swold hampering radio's usefulness and to foster development.

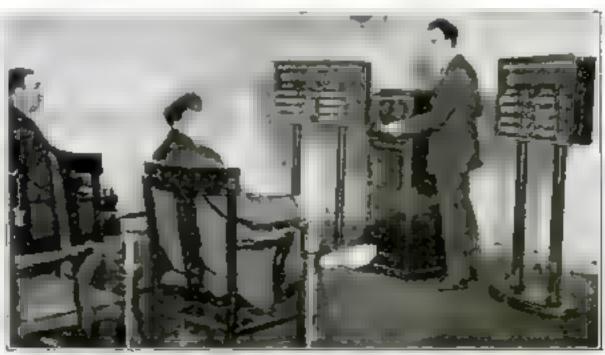
Electric Voting System for Congress

ENABLING all members of Congress to vote simultaneously, simply by presiding buttons at their seats, an ingenious electrical parliamentary voting system, invented by Marshall P. Thompson, of Washington, D. C., was tested and approved recently by members of Congress.

The vote of each member is shown by means of colored lights that flash opposite the names of members on indicator boards.

Further, a complete perforated card record of individual votes, including total votes, can be obtained by inserting a card in a recorder cabinet and pressing a button.

At each seat is a cylindrical stand, in the top of which are four buttons and a lock. Pressure on one of the buttons records a vote of "aye;" a second, "nay;" a third, "present, but not voting;" and a fourth permute correction of a vote.



The complete electrical ballot system, showing button holders at members' seats, indicator boards with names of voting members, and perforated card recording mechanism.

Gun Strap for Hunters Quickly Released

ALMOST every hunter has wished for some kind of a strap that would suppart the weight of his gun, yet would not interfere with quick action when game was in sight. J. R. Tarzer, of Sparks, Nev., is now credited with the invention of just such a strap, equipped with an ingenious quick-release map.

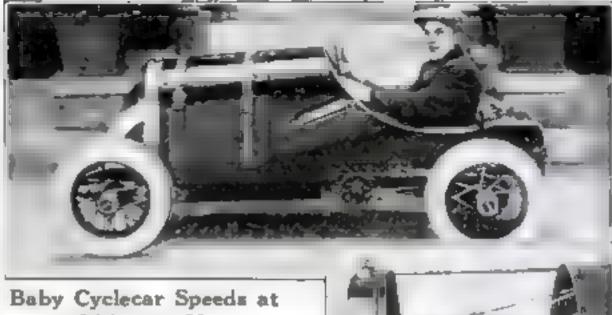
Attached to a gun-supporting belt that is slung about the hunter's shoulders, the



enap encircies the rifle at its center of gravity and is provided with a catch that can be released readily with sither hand when the hunter is ready to bring the gun into action. The release is accomplished by pressure on a lever, when the anap drops away from the gun.

The rifle or shotgun drops into the hunter's hands in a convenient position for

With a little practice, the hunter can relesse his gun in an Instant.

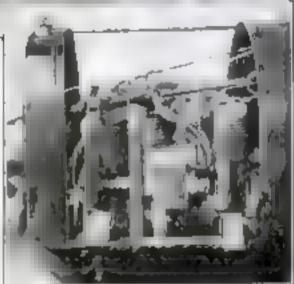


80 Miles an Hour

DIMINUTIVE pre-man state car-A said to attain a speed of 80 miles hear and remaining the advantages of larger wire is in uppped with a three-speed transmission and a powerful four-cylinder nir cooled engine

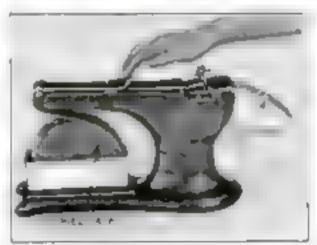
The clutch is controlled by a pedal and gent shifting by a short lever. The transmission drives to a farkshaft and thence by side chains to the rear wheels. Brakes operated by lever act on the rear wheel drume.

The entire car weighs 800 pounds and clears the ground by only six inches.



The diminutive car, weighing only 300 pounds, and its powerful four-cylinder air cooled angine

Package Sealer Moistens Gummed Tape



AN IMPROVEMENT in the use of glued paper strips to replace cord in tying packages, is found in an appliance that enables the operator to unroll a desired length of the tape, moisten the glacd side, and place the strip upon the package without onling his fingers.

The dry roll is placed on a spindle and the loose end is carried over the top of the device, passing through a catch and over a moistening roll. To operate, the catch is pressed down and drawn forward, carrying the tape with it as it passes through the mossleper.

Motor Truck "Delivers" Portable Amplifier

Standing beneath a towning telpod sup-portingsizioudquaking horns, thespeaker tulks into a microphone transtable before him, while his voice, amplified by apparatus in the track, is carried by the home to his audience

POWERFUL amplifying apparatus with six-hors loudspeaker, devised so that it may be carried complete in every detail on a specially equipped motor wagon. and moved rapidly from place to place, is now in use in New York City and vicinity for amplifying addresses by noted men.

The motor wagon carrying the amplifier in parked as close so possible to the speaker's stand. Wires connect the amplifier with a microphone transmitter placed on the table within eight feet of the speaker The speech, amplified by equipment in the wagon, is carried to the audience by six loudspeaker horns which are elevated by a

All the electric current for the apparatus, including that used in illuminating the wagon and for small power took, is drawn from storage batteries. Wiring is arranged for plug connections.

The control panel of the system, on

which amplifying vacuum tubes are mounted, is placed on rubber pade and suspended from spring arrangements which check vibration, thus protecting the tube filaments. All extra parts are carried in specially built felt-lined

A specially designed cover for the top, sides, and rear end of the car is arranged. so that it may be raised and used as an



How the motor truck amplifying apparetus is hasked up to the speaker's stand and to the loudspeaking home

Basket-Like Cave Stairway Built without Rivets

"WO hundred feet below the earth's surface in a deep cave in Calaversa County, Calif., stands an extraordinary example of modern electric welding -a steel tower 100 feet high and seven feet in diameter, containing neither bolts nor rivets, yet so rigid as to provide a firm support for a spiral steel stairway which it

A delicate web of steel ribs, ingeniously woven together, the cylindrical spire appears to the casual observer to be so frague. that a vigorous push might shake it to pieces, yet in actual tests, six men, him ping on the sturms were to be a a milver dollar places a resp. the top say,"

High Ledge Is Starting Point

Rining has some unearth a growth of the indst of grotes to forms the wallate the g com of curety with the first ma sheet basses after mitter one nears of tescent to this may be a first an alterde en capece. the engine of the horses of many fragments phosigeway terminiting at a longe to the cavern wad, 100 feet all ye the por T at ledge was the starting point from which the weided tower was constructed. Formerly a at newbar per lous descent from the leage to the floor was accomplished by means of a long rope and hand contated win tiess.

Because of the difficulties of carrying materials through the narrow passageway to the co. struction aits, the use of riveted angle-from construct on was out of the queslight to be and a sit on were averaged the by inger has test g and the invention, by a Stockton to a regimeer, of unusual electric are welling not see

On the man reign was built first, a reinforced concrete and og platform, from which two short I hearn extended horizontally, like arms to the case throw these anchor atms four steel callies were lowered. to the cave floor, and an electric boost was

installed to raise and lower workmen and materials.

To the cables were then welded a series of steel hoops at intervals of 10 feet, by the following method: At equal intervals around the outside circumference of each

hoop were fastened four short power of I be the agh which the permending ar a les were faread. I Trus. 14 processing has I to to the plant, the hound and is a the first to the co

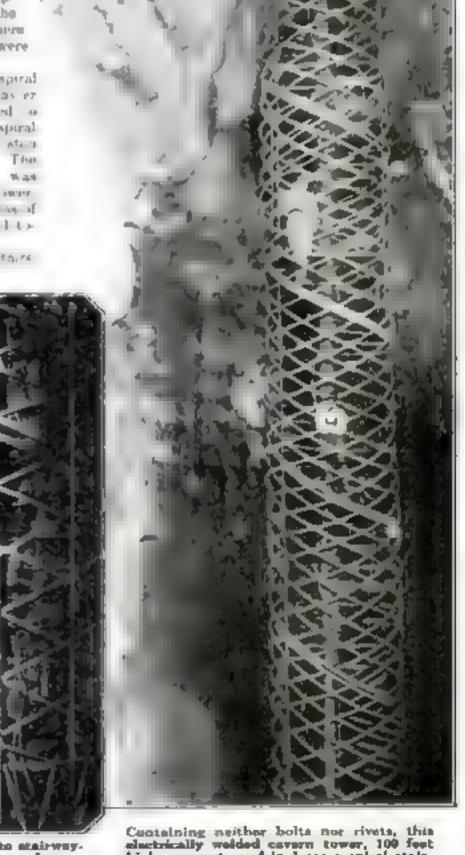
The c al framework con-Siftee by 1 Chas that the a a ways where and his the age flags by town, no the carries is a to be a first on the The I what we to war was tranta tup from the bott to Between ex h location set in of teframe thin, that are us of ateel were bees a spirals. and waven together on the form of a lattice, each strip making one turn around the tower in the 10 feet. Where t - strips crossed they were We test to enjoy to a men

Is a w of one of the apreal Brief GOALER STEEL SEAS OF than the rest work places of happers the same of the appraimark arms for love one other stars to my welsted to Dem offer end of each step was were to gift a things to of the Laurer. cornecting of technology agency of mean as stee tone with the

Resides supporting the stoirs

the bollow central core is used to earry fresh air into the cave and to inclose electrie light wires.

In all, there are 7221 welds in the three tops of steel that make up the tower. representing five weeks of labor.



The base of the welded tower at the care floor, showing entrance to stairway. Note how flat steel strips, bent into spirals, and interwoven about a framework of cables and hoops, are welded together to form a rigid structure

high, supports and lockees a spiral stairway leading to the care floor

What Kind of Exercise Do You Need?

"Keep Your Neck and Abdomen Strong and You Can Count on a Fifty Per Cent Longer Life than the Average Man"

AMERICA is a land of the physically unfit. And one important reason for this is that Americans do not and will not take shough of the right sort of exercise.

Do you really know what is the right exercise for you?

I once wrote a prescription for a prominent banker who vowed that he would not exercise. That prescription, one of the best I ever wrote and one that helped make him whole again, was simply:

"A case and a dog to be taken daily on a walk for an hour before mosts."

Physical Failures

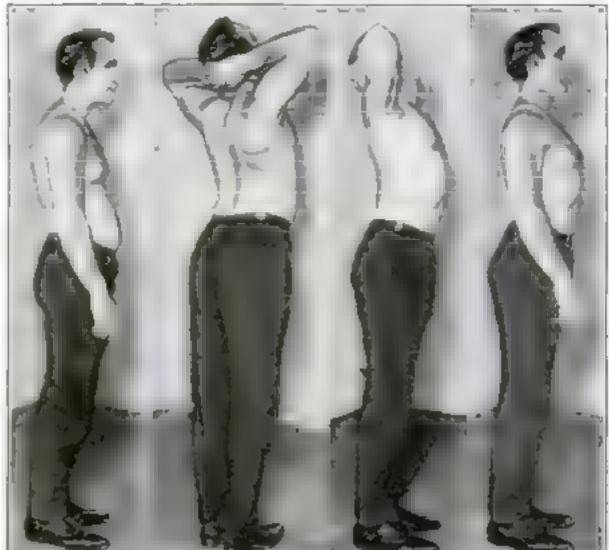
I'd like to prescribe exercise of a different sort for the follow who says:

"Exercise? I get enough exercise? I get my work. I go to bed tired enough at night. Don't talk to me about exercise. I'm too busy."

"Quite so, my friend," I'd like to say to him. "You are the kind of man who was thrown out by doctors in the draft - one of the 40 per cent Americans not fit to fight. We all know you. You are not patriotic amough to keep one and only one

citizen in good condition. You are the reason for the recent man-power conference at Washington, where the Secretary of War, John W. Weeks, called us to consider the physical deficiencies of American manhood as revened by the figures of Surgeon-General Ireland, and to devise remedies for

By Dr. C. Ward Crampton
National Authority on Exercise



Typical careless posture which the article asplains is common to most of us, causing hold ow chest, drooping head, and protruding abdomen. To remody these defects the "star gaser" on errise, shown here, is recommended

The "Star Gazer" Exercise

THESE photographs were posed for Popular Science Mostrolly under the personal supervision of Dr. C. Ward Crampton to allustrate the beneficial effect of his "star gaser" exercise, designed to strengthen neck muscles, to strengthen the spine, raise the ribs to allow more space for lungs, and tone abdominal muscles.

Try this exercise, observing the following "counts"

Position Standing, hands behind the head 'not on the neck's.

1 Head forward, chin to chest.

Head up, "looking at stars."
 Head back, chest up, abdomen in; don't lean back from the hips.

4. Head back as far as possible. Try to look at the back of your neck

5 Press up with hands and twist head first to the right, then to the left.

6. Repeat No. 5.

the alarming prevalence of physical decadence."

If you don't believe that I am right, just consider the report saued by the Carnegre Institution in collaboration with Lieutenant-Colonel A. G. Love, of the United States Army Surgeon-General's Depart-The report ment. shows that 500,000 men were rejected by draft boards on physical grounds. About 2,000,000 reerus La who were examined at military camps, were found to be physically defective.

Rather a sweeping indictment of American physique, is it not?

What Is Exercise)

And what is to be done about it? Proper exercise is one of the answers.

At the outset, we must admit that exercise la a vague term. It may mean anything from flexing the fingers to playing football. Where the movements are the same or constantly repeated, muscular activity, of course, wears down. This is labor. Exercise, on the other hand, is activity used to stimulate repair and growth. It provides variety, a relief

from the labor activity, of whatever nature that labor may be. Its chief benefits accrue after the exercise is over. Exercise causes waste, but it atimulates and cleans the tissue. Rest immediately thereafter provides opportunity for repair and upbuilding, restoration and readjustment.

Correct posture head up, chest high, abdomen in. The

position should be natural and

easy Shoulders

should not be forest back. You will fall into it more

naturally if you

"otar gamer" es-

BPCARR

Five Simple Ways to Test the Fitness of Your Body

These energetic figures, drawn by Doctor Crampton, illustrate a series of tests by which, he says, you may gage your anatomical condition



1 Stand with logs straight and touch your toes



2. Sit with legs atratched out straight and touch your toes



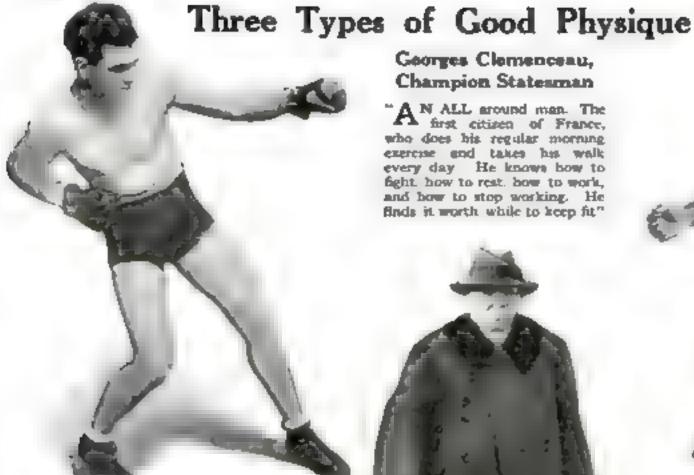
3 Send back from kness, touching floor with your head and forming a bridge



4. Lying on floor, surve your body and legs so that feet touch habind bood



6. Stretch lege forward horizontally while supporting your body with hands. Holdit 10 seconds April, 1923



Georges Clemenceau. Champion Statesman

AN ALL around man. The first citizen of France, who does his regular morning exercise and takes his walk every day He knows how to fight, how to rest, how to work, and how to stop working. He finds it worth while to keep fit"



Jack Dempsey, Champion Boxer

A N OVERSIZED man with big muscles and large organic equipment. Too big and too much muscle for ordinary occupations. Fighters need much physiological exercise, both of low and high speed. Frequently they become stale solely because they lack variety in the psychological side of their occupations

Different kinds of exercise produce different results. The bookkeeper, for example, doesn't need the same exercise required by the salesman; the mechanic needs exercise as much as the teacher; and even the postman who does nothing but exercise (as we usually consider the term) needs planned exercise. Just as our bodies need many varieties of food to obtain in proper quantities the five elements of food-fats, carbohydrates, proteids, vitamines, and ealts—just so do we also need each of three elements of exercise.

The Three Elements of Exercise

Considered scientifically, these three elements of exercise are: Anotomical: For correction and improvement of the body structure. An Illustration of this is the ecal-heaver's arm and hand. Grasping the shavel handle as he does and working his muscles at the same time, the muscles tend to keep the fingers gramped in a grasping position, and it is difficult, if not impossible, for him to straighten them out. Similarly, he cannot completely straighten the arm because of the shortness of the bicepa muscle.

Physiological: Stimulating organic activity. An amazing number of persons, either through lack of all exercise or too little exercise of the right sort, have allowed their intentines to stagnate, their nervous sys-tems to get "on edge," and their hearts to become tired through overwork.

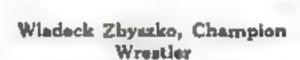
Psychological: Interest, enjoyment, and fun. It is quite true that while you may be getting adequate exercise, you may lose its benefits just because it fails to interest you. The trouble with many men and women is that they do not know how to play when the day's work is over. Psychological exercise containing elements of interest and enjoyment is what they need. Having outlined these three elements of exercise anatomical, physiological, and psychological—as standards, let us find out just why we need each one of them.

Practically all of up need more anatomical exercise. Why? How many men, women, and children have you seen with bollow chests, aloping shoulders, drooping heads and protruding abdoment? Unless you are a physical exception, at least two of these defects and possibly all of them, appear in pourself to some extent. This means that something is wrong anatomically. The structure of your body has developed faults-mechanical distortion or displacement of body parts caused by lack of exercise. And the result is that your vital organs are cramped and depressed. Exercion that will put them back in their proper places and keep them there is required exercise that will lift the head, strengthen the neck, raise the chest, straighten the back, and flatten the abdomen

Faults Corrected by "Star Gazing"

There is one exercise for the back of the neck that every one needs because every one's head is balanced, not in the middle, but toward the back of the skull. To correct the natural tendency of the head to pull forward, one of the most valuable exercises in that described and pictured on page 38 as the "star gazer"

The purpose of this exercise is to shorten and strengthen the muscles of the back of the neck which tend to elongate and weaken, causing the head to droop.



"TESTED by the writer in George Bothner's gymnamum in New York City, and ducovered to be one of the few men ever found in perfect condition. A marvelous frame made up of timues of extraordinary quality. An exceptional type of wrestler Although he is tremendous in size, he is not muscle bound"

The same principles of shortening and strengthening muscles are applied to straighten the spine, to lift the ribs and thus make the chest more espacious, to tighten up the muscles of the protruding abdomen, and, in general to make a man well toned instead of flabby-with a permanent high chest instead of a cavity where his chest ought to be.

If a man can keep his neck and his abdomen strong, he can mfely be guaranteed a 50 per cent longer life than the average man, with 60 per cent more efficiency and 50 per cent less disease and pain

"But how," you may sak, "can I determine whether my neck and abdomen are strong?"

How to Test Your "Filmess"

To help you answer that important question, I have devised the senes of exercises illustrated at the bottom of page 39. They are direct gages of your condition, and if you will find study, then practice them, you will be able to readily determine just how you stand physically. Furthermore, you will be fit as long as you are able to pass these anatomical exercise tests.

But don't fool yourself by thinking that past because your anatomical structure appears to be right, you do not need exercise! Many a man holds his bend high and his back straight by virtue of beredity or early training: yet he may be seriously lacking in vitality and quite as weak as the man who is structurally distorted. Such a man is like the auctioneers' clock "with a beautiful onyx front, but no works to speak of " Nine tenths of American men and women over 40 are in this position. Outwardly, they appear sound, but, if called upon to chase a car or run a hundred yards from danger, they would damage

What Is Your Job? Here Are the Right Exercises for You

Prepared by Dr. C. Ward Crampton, National Authority on Exercise

Pick Out the Class of Work Most Like Your Own











Typical

Deficiencies

Corrective

Exercises

shouldern Stoop hollow chest, weak muscles small weak heart Thinks play in trivial and gradually "dries

Scholar

Mechinist

Chest bound by executive muscle work. Large muscles, limited organic power; cramped internal organa

Postman.

Body damps from constant wear Abdomen weak and bulging muscies, beart, and other organs worm, but sound within limits. Psychologically westy

Laborer

Muscle bound sturage from wears abdorsen TICSE weak Bodily or gans timue bound by work lose clasticity too bard in spots too soft us others. Tired.stolsd

Abdominal muscles. especially require daily setting up execemes. Daily walk may be omitted if work is to fresh atc "Heavy workout" not needed. Should go out of town and réctente half-day

weekly

He Needer

Office Executive

Chest stiffened abdomen bulging PAT 'has-been', muscles weak heart small and weak, or large with hard arterres organis soft Psychologically too senous and too lucks real fellowship

He Needs

Daily cetting up axercises morning and night essential Dany walk needs eary at moderate Moderate pace. workout of game type twice a week vital. Two half days out of doors at golf or its equivalent

He Needs:

Vigorous setting up exercises each morning and even-Daily walk kng. for 45 minutes. Henvy "workout" three times a week Weekly half day recreation out of dears necessary

He Needer

Daily setting up exnecessary encises for neck and anatornical correction. musuté Twenty walk each morning and night Boxing and wrestling twice a week Weekly half-day bike out of doors

He Needs:

Setting up exercises each morning and evening vital to cor rect slump. Walk ing not needed for Chereson. Heavy workout necessary twice a week for chost periods Should stay indoors for weekly half-day

themselves seriously and perhaps even die from the offects.

To robe id their "workings"-the heart, lunge, and digestive organs—these persons need physiological enercise, starting with the lightest form of this exercise and gradunity increasing it until a aplended mechanism is restored, available for use in every reasonable emergency and enduring for a iong, useful, and happy life.

One of the most striking examples of the auctioneer's clock type of citizen was a patient of mine who had played football on one of the great college elevens with such

suggess that for two years he was named as the All American fullback. He was a splended fellow six feet two, 190 pounds, hend up. back straight, clear eye, and clean skin, with a fine war record behand him. Yet I found that his blood pressure record was 60 per cent of normal, and the general index of his physical condition only about 50 per cent. Corroborating these proofs of deficient internal condition, was a soft layer of supe-grown fat distributed evenly over his splendid frame. I sent him to a gymnasium, and visited him at his work two days afterward. He complained of the "childrah" exercises that I gave him, recalled his athletic record, claumed to be in fine shape and wanted to play bandball.

He needed a leason So I gave him a fair competitor and watched him play handball for five minutes. Then I took his pulse. His heart was throbbing wildly at the rate of 162 beats to the minute. He was soft inside as well as outside. His heart and his blood circulation system were out of training. He needed physiological exercise, but not of such intensity.

What happens when we exercise? Let me explain that muscular contraction in

> execcise culls upon the circulation for more blood. In a muscle that is being exerciecd, the blood content is increased from four to 10 times, depending on the kind of exercise. tracting muscles draw on the blood for oxygen, and they want it quickly. As a result the entire blood circulation thecharism is atimulated. The heart beats faster, the blood pressure rises when the splanchnic veins in the abdomen in which the blood was previously stored contract, and the whole body machinery is whipped up and readjusted

The ductiess glands

becomes more rapid to supply air to the blood and to prevent the accumulation of carbon dioxid in the body. The lymph channels become more active, cleaning up the muscle waste as the exercise continues. In short, the whole set of body organs is speeded up.

if the exercise in vigorous and the body machinery in good order, the initial distress of activity gives way to a feeling of comfort and pleasure in movement and power You may recognize this feeling as "second wind." But if the machinery is unused to hard work, there results trouble, waste, and strain. In other words, the body, when the machinery is not in good order, is organised for only the lightest work, has no margin of power, and when called upon for activity. into hurtful disorder.

throw out secretions known as hormones, which enter circulation and act as mosaccigers to the various organs, coordinating their activities. Preparations are made for drafts on the most available food supply from the glycogen and the liver. Breathing

Danger of Over Exercise

Everybody needs physiological exercise to keep the body muchinery in health, with a margin of power for reasonable smergencies. Yet we must be careful not to over exercise and thus wear out the bodily machine. Scientific investigation tells us that the hest physiological exercises are those that are the most natural and in which the muscles act in their most accustomed ways. These are exercises of the large muscles rather than small ones. Waiking, dancing, running, climbing, swimming, boxing, and playing active games are often the most useful ways of getting physiological results.

The postman is a good example of the man who needs physiological exercise. True, in continuous walking he gets a certain form of the exercise. Yet while his organs are working in a going concern, they may not be able to support him in vigorous exercise like running.

(Continued on page 41)



A Physiological Test

"RUN" in one spot, 90 steps to the half minute, rausing heels to touch hands. Your pulm should return to normal one minute after

His equipment, in other words, is effective up to a certain low limit of strain. What he needs in physiological exercise that will increase his limit.

On the other hand, the tired business man who never "rauses a finger" needs all kinds of exercise.

To determine your physiological efficiency, test the reaction of your pulse after "running" 90 steps to the half minute on one spot. In running, the heels must be raised to touch the hands, as shown in the illustration at the bottom of page 49. Note your normal pulse beat before the test, its rate afterward, and the time it takes the pulse to return to normal again. This nterval should not be more than one minute.

Why Men "Go to Seed"

We now some to the third and last element of exercise—the psychological. Many men go to seed mentally, morally, and physically because they do not know what to do with themselves at the end of a hard duy's work. They never have learned how to play, and they do not know how to have a good time except in some crude, destructive fashion. They take no exercise because the only exercise they know of is some advertised course of movements that they would have to do alone, without the sest of changed anvironment or friendly compotition. It's no fun. If they could have some pleasure with their exercise, they would exercise

The exercises that are enjoyed most are these that nature approves for us. Nature wents children to run and jump, play hide-and-seek, climb, throw, and swim. And they do these things if we permit them. Once Nature Insisted that man, if he would live, should fish, hunt, and take many beneficial outdoor exercises. That's why we still like to hunt, fish, swim and ride borses, bicycles, automobiles, and seroplanes.

Baseball Fan Gets Exercise

Nature, too, wents children to stand up for themselves. Hence she encourages competitive games, full of dares, trials of speed and courage. We all like a contest Nothing will draw a crowd so quickly as a

Thirty thousand men watching a bandful of baseball players in a big league contest are indulging the competitive instinct and participating in the struggle. When Babe Ruth slams a homer, every man of the 80 000 participates in the glory of it. The is pure psychological exercise, without bodily exercise except cheering; although a very definite anatomical exercise occurs at the seventh inning when every one of the 80,000 stands up, contracts the muscles of the back and neck, straightens the dornal opine, and lifts the ribs -a very natural and very effective structural exercise.

The contest idea is responsible for golf, which is low in physiological value compared with more strengous games, but high in psychological exercise value, because a keen desire to "beat the other fellow" is combined with walking and swinging the arms and body

To keep physically fit, every man needs a balanced ration of exercise enough of the anatomical, physiological, and psychological to make the strengthening of muscles and the correction of body structure play rather than work for him. The subject of exercise is as many sided as life itself -a fracinating, actentific study. It is coming into a larger service as more acientific menenter the field. And wase is the man who keeps himself in 100 per cent working order.

History Recorded by Giant Tree

MILEPOSTS in the world's histary for almost 1000 years are marked by the growth rings on a cross section of one of the giant Sequoia trees of Yosemite National Park, recently upcooted by a storm To demonstrate the tremendous age that the great Sequoiss attain, Ansel F Hall, the park naturalist, has marked on the cross section of the tree those rings that measure the growth of the tree at the

Although the tree was 14 feet in diameter at the base, it was comparatively young as compared with other Sequoins still living. One of these, the Grizzly Giant, is 29.6 feet

time important his-

toric events were

occurring.



wide at the hase and its age has been estimated at 4000 years.

860-CMILWAR

776-DECLARATION OF MOEPENDENCY

620-LANDING OF HE PILLA MS

492-DISCOVERY * "-MAGNA

CHARTA DUG-BATTLE OF HAUT NOS

Each ring marking a stage in the thousandyear growth of the Sequete in inbaind to show the tant contemporary

Tailboard Engine Drives Gas Railcar

GASOLINE motor-driven railcar of novel design, senting 30 passengers, has been invented by A. R. Meister, of Sacramento, Calif., and put into operation on the Hetch-Hetchy Railway

By placing the motor at the rear of the driving wheels, the inventor has climinated all revolving parts in front of the rear axle and has done away with the noises and gesoline odor that have proved to be serious drawbacks in other gasoline railcars. The engine is supported through collapsings at the rear end of an auxiliary frame, extending back of the driving wheel.

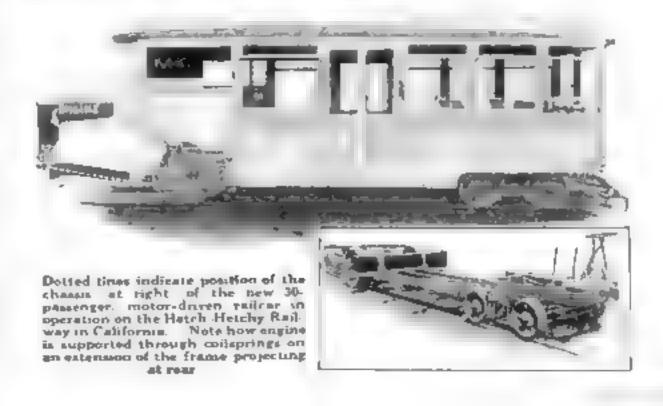
The centing capacity has been made unsmually large by hanging the car low without lengthening the wheel base

The subframe forms one ball of a complets truck, having a swivel bolster built into the main frame so that it turns at curves, eliminating flange wear and relieving the side thrust. Although the car weighn 10,400 pounds, it is said to make eight miles to a gallon of gasoline. It is also claimed that the car negotiates a five per rent grade 12 miles long with numerous curves at a speed of 27 miles an hour

The vibration of the car is said to be negligible.

THE popular idea that it "takes a big man to be a salesman" was exploded recently by a acientific study of the sales records of 600 salesmen, which proved that the most successful selling is done by men of about five feet name meches tall

Dr Harry D. Kitson, of Indiana University, recently presented the findings of this research to the American Psychological Amecution



Underground Radio for Mine Rescues

EXPERIMENTS just completed in the United States and England indicate that wireless communication with miners in the underground workings of mines soon will be possible, providing a tramendously effective aid to rescuess when explosions or other disasters trap workmen far below the surface.

Experiments in Mine Case

Experiments in England were conducted by the Sheffield Wireless Society at the Blue Johns Mine, which is in reality a hage natural cave. An aerial consisting of a single strand of copper wire—was suspended on insulators across one of the diameters of a "room" of the cave, 10 feet above the level of the floor. A ground connection was made with the instruments by running a hare copper wire a short distance out of the cave, down a tunnel where there was a running stream of water

The broadcasting station was 21, miles away and the serial in the cave and feet, below ground level. Audibemessages were transmitted and received at both ends. In the cave an ordinary spark transmitter was used for transmusico, while a short wave tuner with a reaction coil added and a three-stage detector actiplifler were used for reception. At the broadeasting station a similar gourk transmitter was used, and for reception

a set using one radio frequency amphilier, a detector, and three audio frequency amplifiers. Memages passed freely in both directions.

The experimental coal mine of the Bureau of Mines at Bruceton, Pa., was used in the experiments conducted in the United States. These tests disclosed the fact that with a receiving set at a point 100 feet underground, signals from KDKA

Station, East could be from the from th

point received 280 feet underground

could be heard. The station is 18 miles for a the experimental mine. A six-men or aned with iron pipe and contain-

From a broadcasting station two

ing electric light wire 50 feet from the receiving set evidently aided in the reception, for when the apparatus was carried away from the bore hole, arguals were harely audiale through 50 feet of cover

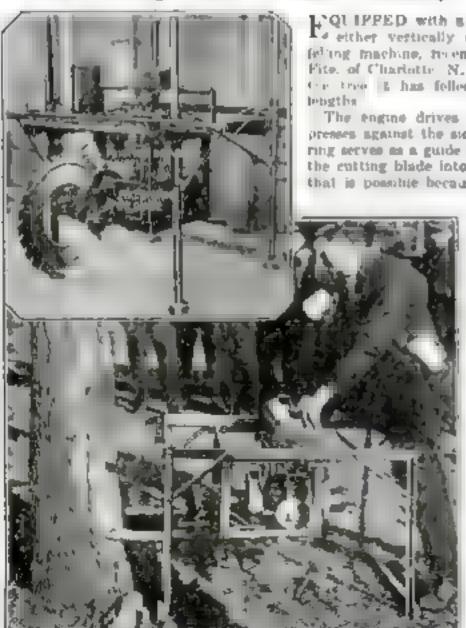
In transmitting through 50 feet of coal strata, continuous waves of from 200 to 300 meters length were used. Experts believe that longer wave lengths will make possible receiving and transmitting messages at greater depths.

In all experiments vertical antennae were used, horizontal antenna gave no results. The strata of the experimental mine he horizontally and this is beneved to have some influence on radio waves.



The underground aerial is a single

wire strung across the mine room



For tree falling, the circular saw blade is adjusted in horisontal position. Inset shows saw in vertical position for cutting logs

Colling of the state of the sta

The engine drives a friction drive which present against the side of the saw. A fixed ring serves as a guide for the saw and follows the cutting blade into the cut—an operation that is possible because the thickness of the

guide is less than that of the cutting teeth. Thus, the machine can fell a tree the diameter of which is three fourths that of the anw. For a tree of greater thickness it is necessary to make several cuts from various points on the circumference of the tree

The engine, caw, and sumilary apparatus are mounted on a light frame, the legs of which can be adjusted in length so as to obtain a horizontal cut at any desired beight above the ground within the operating radius of the machine.

When cutting logs, the axis of the saw is turned through 90 degrees and in on apright position.

Extension Arm for Phone Holds the Receiver

THE atrace of holding a telephone receiver to the ear for long periods has attracted the attention of inventors and a new telephone instrument recently placed on the market is equipped with an extension receiver that can be adjusted and held



How extension is attached to talephone receiver and adjusted to the subscriber's ear

stationary in any convenient position, thus leaving the user's bands free.

The receiver, to which the extension in attached by means of a flexible tube, is hung from a bracket attached to the telephone stem, while a ball weight serves to keep the hook down when the instrument is not in use. When telephoning, the user lifts the weight and piaces it upon a bracket, thereby releasing the hook. The extension is adjusted by bending the flexible tube.

The Year's Greatest Adventure for the Radio Fan— Listening In on Transatlantic Messages

Inventors Talk across the Sea without a Carrier Wave

By Jack Binns

America's most popular writer on radio

If he has been betten by the long distance bug, this springtree promises the biggest and most fascinating of all the adventures that have thrilled him in the past couple of years. It is this:

If he is patient and persevering, and if he learns how to make a few changes in his receiving set, he is going to listen in on two-way wireless telephone conversations across the Atlantic!

A Revolutionary Invention

That promise is made possible by an invention that marks one of the most revolutionary advances in rathounce Marconi transmitted the letter "S" across the Atlantic 21 years ago. The invention, known as "side band transmission" was demonstrated to the public for the first time when officials of the American Telephone Company recently spoke from a New York City office building to a group of dutinguished scientists in London

It is revolutionary and autounding in that it does the securingly impossible it actually carries voices across the other without a carrier wavel. It is the first germ of commercial transatiantic telephone communication; for it means, among other things, that

Voices can be carried across the Atlantic by radio on one third the power output that otherwise would be required.

Interference—the clashing of radio waves is lessened, permitting several messages to be sent at the same time on wave lengths close together

Two-Way Conversations

Two-way duplex voice conversation across the Atlantic, though not yet attempted, is assured for the immediate future. And when it is tried, it will open a splendid opportunity for radio fans all over the country to test their ingenuity in designing sets that will be capable of producing this wonderful new form of transmission

But first, just what is "side band transmission"?

Until a few months ago, the so called "ade band" radiation that accompanies the modulated radio carrier wave constituted a baffling problem in radio transmission. Then a number of radio engineers began a systematic search for a means to eliminate this interference. They spent weeks of patient research at the great Radio Central station at Rocky Point, L. L. where giant 10-kilowatt vacuum tubes had been especially installed to transmit to observers located at various points in Europe.

The astounding outcome was this:
While successfully suppressing the "side bands," they made the amazing discovery that they could more effectively suppress the carrier waves and transmit on the very



Jack Binns, world famous radio supert, who talls in the accompanying article how you can adjust your receiving set to catch transatlantic radio messages

POPULAR SCIENCE MONTHLY— Your Radio Textbook

FOR every man or woman, boy of girl, who owns a radio set and for every ciber person who hopes to own one. Popular Science Montilly is stidispensable

in the pages of Popular Science Monthly every month you will find the latest developments in radio science that are the most important to YOU

And you will always find a wealth of useful ideas that will add new piessure to your radio set.

For example, this month, is addition to the tremendously important article by Jack Bune on this page, you will read

histow you can build your own dry cell vacuum abe set for \$20, on page 75.

Vifore to assemble a three-stage loudspeaker set, on page 98.

What other radio lane throughout the country are asking. On page 123 our Radio Information Editor a clear, instructive answers to their six most pressing questions will help you solve your radio problems.

"side hands" they were trying to eliminate!

Without attempting to go into technicalities, we may describe the side bands of radio transmission as two secondary waves produced on each side of the modulated carrier wave by interaction between the voice wave and the carrier wave. Of these two eide band waves, one varies in frequency from about 200 to 2000 cycles a second more than the carrier wave, while the other varies in frequency from 200 to 2000 cycles less than the carrier wave.

There are, therefore, three distinct waves and out by a radio transmitting station the modulated carrier wave, and two side band waves. Naturally, these waves cause interference with any other waves in the other that are close to them in frequency.

In the first experiments, one of the side bands was eliminated entirely by means of fiter circuits. The thought then occurred to engineers: "Why use a carrier wave at all?" They realised that if the carrier wave and one of the side hand frequencies

> could be alimizated, the use of the ether would in this way be increased threefold.

> So the carrier wave, along with one of the side bands, was suppressed by a filter circuit. But the big task now was to actually receive the remaining wave side band, since the ordinary type of receiving set would not function under such a condition

A Special Receiver

A receiver was produced with farcilities for setting up separate locally sustained oscillations corresponding exactly in frequency to the carrier wave produced in the circuit at the transmitting station in order to create the side band wave, and then suppressed

In the new receiving set, the interaction ortween the local sectlations and the side band wave, as received, produced a wave in the receiver corresponding exactly in form to the voice wave produced at the transmitting station.

We are now sesured that with the 100kilowatt transmitter operating at Rocky

Point, it will be possible to receive the transationtic signals in all parts of the country during the daytime.

How to Listen In

The best way to do this with present apparatus undoubtedly is with a regenerative receiver of the honeycomb type, using coils large enough to tune up to 6000 meters. For this purpose it will be necessary to use a 800-turn coil in the primary, a 400-turn coil in the secondary, and a 200-turn coil in the tickler. In the primary circuit the tuning condenser with have to be shunted across the honeycomb coil instead of being in series with the serial.

This receiver in itself, however, will not be sufficient. It will be necessary to use an oscillator to provide the missing carrier wave

frequency. It is here that the ingenuity of the fan himself will have to come into play, for he will have to discover for himself what that frequency is.

The oscillator can be constructed by placing an inductance in the grid and plate circuits of a hard vacuum tube. It will be necessary to place variable condensers in shunt across the coils, and the latter will have to be placed in an inductive relationship with each other. Tuning for the minting frequency will be done with the condensers. There will be a loose coupling between this oscillator and the main receiving set. The coils probably vill duplicate the main primary and secondary.

Flashlights Reveal Frog Monsters

Camera Hunters Find Strange Reptiles

E XTRAORDINARY flashlight photographs of strange barking and climbing frogs that inhabit the coral

island of Sunto Domingo in the West Indies form part of a valuable collection of reptilian life recently gathered for the American Museum of Natural History by Dr. and Mrs. G. Kingsley Nobie.

In one of the most unusual arientific expeditions over undertaken, the explorers used automatic fleshlights to photograph from in their native baunts. Months of preparatory labor were spent in perfecting this method of photography, which Doctor Noble first practised in obtaining pictures of from that Infest New Jersey meadows.

In addition to their large collection of photographs, preserved specimens, and skins, Doctor and Mrs. Nobie brought back nearly 40 living specimens of the largest

hazds in the world, believed to be direct besence to of grant prohistorie repodes a tage trial frogund on as azeg man and frog that there are a logic discussalike a org."

The Santo Don'ngo borned limit with some ones reaches a length of the feet, has an ener-

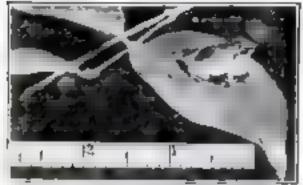


The climbing tree frog. discovered by Doctor Noble and photographed by a magnesium flexblight as shown at the right. The small circle shows location of frog in the foliage.



Delieved to be a descendant of glant probletoric reptifes, this strange horned listerd was discovered on Sento Domingo Island by Dr. and Mrs. G. Kingsley Noble, above





One of Doctor Noble's remarkable fashlight photographs of the Santo Domingo "backing frog." Note throat air chamber used by frog in producing buge noises

moun head, powerful jaws, a wide gaping mouth with deep indigo interior, a red tongue and little pink projections dotting its face. The entire upper body is armored with a crest of spines running from the back of the neck to the tail. It bears a close resemblance to certain dinogaurs.

Natives of Santo Domingo believe that would barking sounds, which emanate from their forests at night, are caused by ghosts. Doctor Nable traced these noises to tree from Even more curious are the

larger tree from that batch from their to their the pass are rand their control to development with a still in the water The wagla period or to be a dispersion as a strategy as a control to the area a person as as count of their areas as a count of their areas as a control of their are



This preserved specimes of tree frog shows the octopus the suckers on its feet used in a mixing frees or in attaching Itself to stones in a swiftly flowing stream

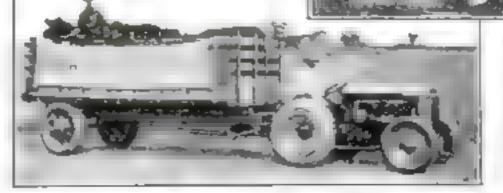
Two-Wheeled Fordson Trailer Clamps to Rear Axle

A TWO wheeled trailer of the dead sale type, that will follow in the tracks of the towing vehicle, has been designed for direct attachment to a Fordson tractor through adapter eastings that clamp solidly to grooves in the rear axle housing of the tractor, immediately inside of the wheels.

A wishbone shaped frame that acts as a swinging tongue, is pivoted to the rigid rectangular frame in such a way as to allow the tractor to turn sharply without turning the main frame of the trader until the frame reaches the point where the tractor started to make the turn. This facilitates the movement of loads in cramped places.

A drum on the axie housing of the tractor enables the driver to soub out of holes by attaching a 100-toot cable to a dead-man and winding the other end around the drum. The tractor can thus wind the cable and haul itself, by its own motive power, out of difficult places.

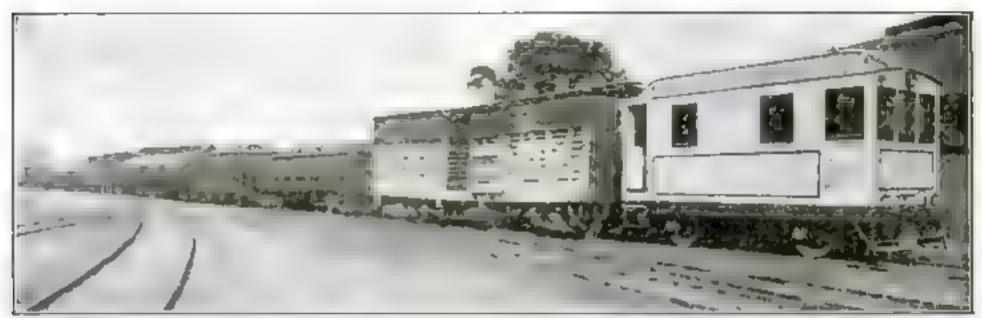




Upper loft: Frame
of the two-wheeled
trader, a how rig
pivo ed members
At left The complate tractor trade
et Above Rear
axle of tractor,
showing adapter
castings and drum
for anubbing out

Oil Transmission Drives Gearless Car

Extraordinary Invention May Revolutionize Speed Control



Haufing care weighing 645 tone, this gesoline locomotive, with 150-horsepower engine, has applied the oil drive transmission system with such success at to promise gentless transmission for automobiles. Engine and transmission give a maximum speed of 12 males an hour

ILL clashing gears and shipping clutches—the bans of automobile drivers—soon become things of the past?

The promise that gearless transmission may soon be applied successfully to pleasure cars and motor tracks is offered in the recent effective application of an ingenious oil pressure drive system to a gasoline switching locomotive—an achievement accomplished by John Robson, chief engineer of the Universal Engineering Corporation of Montreal, Can.

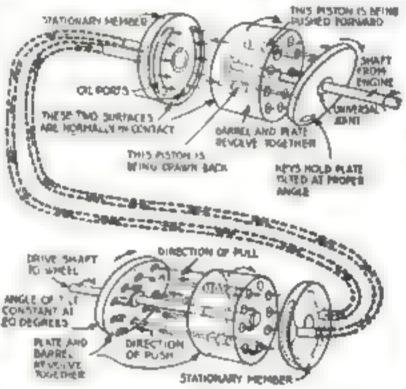
Because it provides a practical method of eliminating gearbox, clutch, countershaft, and possibly the differential in automobiles, the invention has been hailed by engineers of the company as a revolutionary development in speed transmission

Without gears, how is the power of the rotary gasoline engine transmitted to the wheels of the car? Simply by reciprocating motion of oil under pressure

an oil flow created by an oil jump unit driven by the engine, and delivered through pipes to a motor unit that drives the wheels.

These two transmission units—the off pumping unit and the driving unit to which the oil is delivered under pressure—are similar in form, yet opposite in method of action. Both operate on the same principle, which is this

If a balanced disk is mounted on a pin or shaft in such a manner that it tilts at an angle with that shaft, any force applied on either more of the disk was cause the disk to rotate - provided friction is sufficiently reduced. For example, an ordinary bicycle wheel held at an angle with the horizontal



This diagram shows operation of ell pressure transmission as applied in switching lecomotive below. At two is the ell pumping unit actuated by engine drive-shaft, and producing flow of oil that operates the wheel driving unit

will rotate until the valve has reached the lowest position, the weight of the valve corresponding to the force applied to the side of the disk mentioned above.

Similarly the rotation of the disk will exert a force parallel with the axis of rotation.

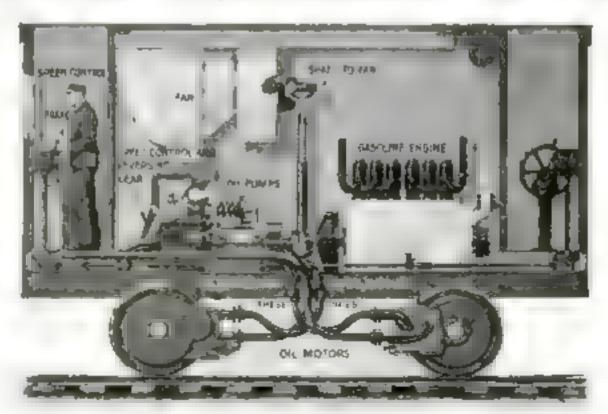
Just such a revolving tilted disk is the actuating part of the oli pumping transmission unit. It is called the "nocket ring" because it contains a circular series of nine sockets. This socket ring is attached to the engine drive shaft through a universal joint. Inclosed in the same case is a barrel of nine cylinders through which move nine putons actuated by connecting rods. Three rods are feetened into the ring sockets by means of balls, producing a universal joint arrangement. Thus, as the engine shaft turns the socket ring, the pistons are moved back and forth in their cylinders.

At the end of the cylinder barrel opposite the socket ring is a circular stationary member or valve plate containing portholes through which oil is forced into and drawn from the transmission pipes by the action

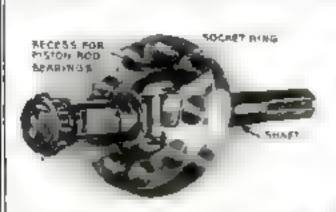
The second, or wheel driving unit, in similar in construction, except that the order of operation is reversed and that the socket ring remains at a constant 20-degree angle of tilt with the vertical

of the pistons.

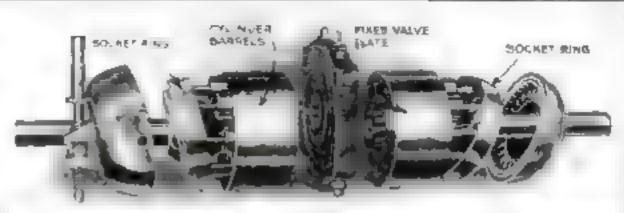
in operation, the epters system, including the two units and connecting pipe, are filled with oil. As the drive-shaft of the engine revolves, the motion of the tilted socket ring of the oil pumping unit causes four of the pustons to push forward and four to pull back, while a ninth piston is at, or near, dead center. The result-



Diagrammetic cross section view of gasoline switching ongine pictured at top of page, showing arrangement of oil transmusion system. Note that the operator obtains any speed desired, or reverse, simply by moving a lawer



ACTING as a pump, the ingenious driving unit of oil pressure transmission, shown above, consists of a tilted disk, or socket ring, attached to the engine drive shaft through a universal joint. As the ring rotates with the shaft, nine platons with rods bearing into the sockets move back and forth, producing flow of



oll under pressure through transmission pipes. Speed is governed by the angle at which the ring is tilted.

The two transmission units with similar parts, yet opposite in action, are shown in illustration at right. The unit at the left is the pump in which rotation of the engine drive-shaft, acting through tilted socket ring.

sets pistons in motion, producing reciprocating motion of oil stream. At right is the wheel driving unit, or motor, in which the oil, passing through ports in a fixed valve plate, is taken up by pistons bearing against a tilted socket ring fixed on the wheel drive-shaft, causing the ring and shaft to rotate and thus turning the wheels

ing pressure movement of oil down one pipe and back through the second pipe, passing through the portholes of the second, or wheel driving unit, is taken up by the pistons in this unit and converted into rotating motion of the second socket ring. Thus, on one side of the wheel driving socket ring there is a series of pushes, white on the other side is a series of pulls, resulting in a tendency to turn the dask. And since the cylinder barrel moves with the socket ring, the pushing pistons become pulling pistons as the ring revolves, thus insuring continuous rotation of the wheel drive-shaft to which the socket ring and cylinder barrel are

Obviously, the amount of tilt of the

socket ring in the pumping unit governs the speed at which the wheel drive-shaft turns for the greater the tilt of the ring, the greater will be the push and pull exerted in the oil by the pistons. Or, to put it differently, if the socket ring were not tilted at all, the putons would not move back and forth. Likewise, if the tilt of the socket ring is reversed, the flow of oil through the paper is reversed correspondingly. Consequently the rotation of the wheel driving nocket ring is also reversed, imparting a backward motion to the wheels

Thus the driver of the car may start the machine from rest, obtain any speed destred up to the limit, without steps or gradations or reverse, simply by moving a lever that

regulates the tilt of the first socket ring. Any speed can be attained without varying the speed or direction of rotation of the engins. No clutch pedal or gearshift is required.

The constant flow of oil through all the working parts keeps the engine and transmission thoroughly lubricated. Since no parts are brought into violent contact, as a the case with the present gearshifts, the life of the transmission system should be greatly lengthened, the designers believe. Stripping of geam would be impossible, Even if the tilting lever should be moved wrongly, the all would prevent immediate reversal of power. The car would simply stop gradually, then start reversing.

"Brake" Airplane

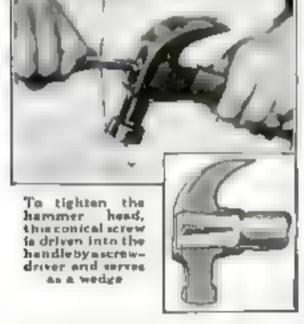
ONE of the most difficult problems of flying-that of reducing the speed of a high powered airplane to a minimum without slowing down the engine-has been solved to some extent by a Frenchman, M. Bille, who has invented an airplane in which

Telescoping Wings

the wing surface can be mechanically increased, thus cutting down the speed of the machine.

Early inventions for varying the size of wings in flight lacked wing rigidity necessary to safe flying. Bale's invention overcomes this handicap by means of two paint of extension wings that telescope snagly the main wings of the plane, so that an be extended or taken in at wit

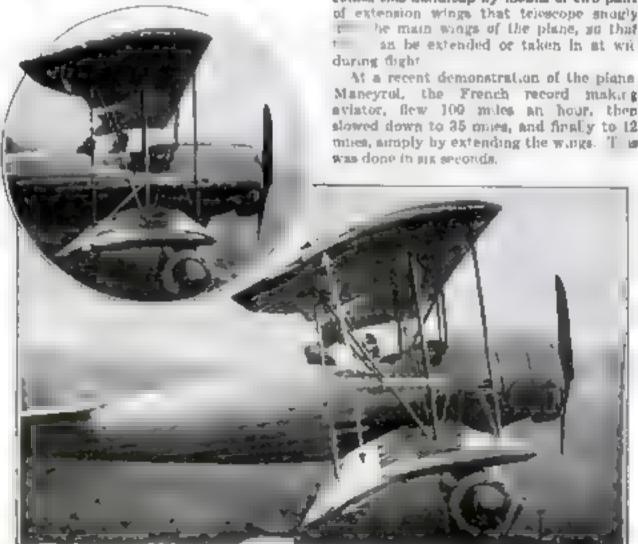
Maneyrol, the French record making aviator, flew 100 miles an hour, then slowed down to 35 miles, and finally to 12 mises, amply by extending the wargs. The



Headless Screw Tightens Loose Hammer Head

READY means of tightening the A handle of a hammer, hatchet, sa, sledge, or other tool of the impact type is provided in a take-up wedge perfected by Fayette R. Plumb, of Philadelphia, Pa., who apparently has solved a century-old problem of invention.

The new wedge consists of a conical beadless screw that is inserted in a hole at the top of the handle. The hole is drilled somewhat deeper than the length of the screw and is reamed to fit it. The larger end of the screw is provided with a slot to receive a acrewdriver and in this way the wedge to driven until it is flush with the end of the handle. Should the hammer loosen, it is necessary merely to drive the screw in farther, spreading the wood against the sides of the eye and thereby turntening the handle.



To reduce speed in flight, the telescoping wings are extended, as shown above, increasing wind resultance. Inset shows the Bille plane with wings telescoped

How Far Would You Trust These Men?

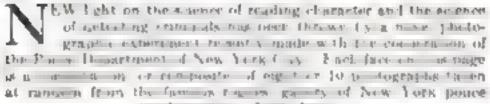
Each One of These Photographs Has a History—Can You Read Character Well Enough to Guess It?











head sharters. Each faire in a compact of a specific type of compact.

Note have different from talled by a granter of probability and a first and give ure The east how good a arge of fives you may to transa was res was I see port as mar to be go as Nest prior to the rade corumn of the fellowing page and real with mass on h wrong fore ar sally no Burgue forger man terer highwayman or l e interfelter are among the group tan too spitan of from before you refer to a NES GARROWS

This test may belo seed answer in your map ment he whether or a case are horn or are made to recommitmee hard luck and ever associates. One theory that of the noted Italian crompalogust Loin bross who set the world to a contract of an page 11.









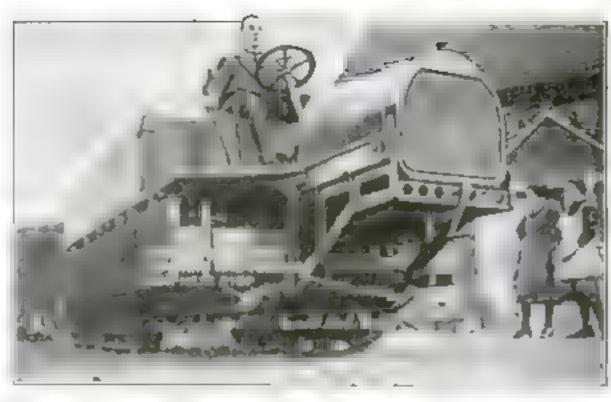


Spiral Wire Holds Tennis Balls to Racket

DESIGNED for players who do not use a racket case with pockets or for those who use no case at all, a new tenna ball holder has recently been invented by Thomas Beets, of Independence, Mo., and consists of a single spiral brass wire that holds two balls firmly against the racket, one ball on each

side. When not in use, the wire is shoped of the racket and hung on the nat

How spiral wire holds tennis balls tightly to racket



Wheel-Less Truck Walks on Metal "Feet"

A NEW wheel-less motor truck that actually walks on metal feet is the invention of a German manufacturer. The "wasking" truck is a development of the tank idea and is equipped with two sets of runners, each of which has five heavy metal "feet" that sink into heavy or muddy ground and thus gain traction.

While one set of runners is being raised and moved forward, the weight of the truck rests on the other set. As the forward moving set gains a fonting, it pulls the load forward, while the other set repeats the motion-nimitar to the walking motion of a human being or an animal, conveying beavy loads on comparatively little power.

Maple Sap Piped to Sugar Camps

IN THE sugar maple groves of the north-ern United States and Canada, modern scientific methods have come not only to mave time and labor, but also to make the processes of manufacturing maple syrup and augar more sanitary. Where once the maple and was gathered by hand in open wooden buckets, today many of the groves are equipped with pipe lines direct from the trees to the evaporating pane in which the gyrup is made.

Usually the "sugar orchards" are located on hillindes which, during the session when the aweet sap flows, are covered deeply with anow, offering difficult footing for

men and horses. Formerly each sapgatherer was supplied with pails, hung from a yoke slung across his shoulders, and into these pasts he poured the sap that had accumulated in wooden buckets hung on the trees beneath the tapa

When filled, the pails were emptied into a tank attached to a sled, which was hauled down the hillside to the "sap house," where the syrup was made. The tremendous amount of hand labor required by this method may be realized from the fact that a harrel of sap makes only about a gallon of maple syrup.

Adopting improved methods, the more

progressive farmtoday have spelvanda with networks of 1 Worker It the fi. of r to fr Baron word, and pour 6. h 15"

Above The new way From the maple grove, the sap accumulating in buckets on the trees is poured into pipe lines that carry It by gravity to the sugar camp shown in the right background

At right: The old way. From open wooden buckets hung beneath the spouts on the trees, the sap was collected in pails hung from w yoks slitny across the shoulders of the sapgatherer

6 2 8 Key to Faces Shown on. page 47 I. Swindler (grand farceny). _2. Bur-

glar (second-story man), 3. Firebug. 4. Forger, 5. Burglar (sefe-cracker). 5. Fickpocket, 7 Murderer, 3, Rebu ber, 8. Counterfeiter

(Continued from page 47)

ing a few years ago-is that criminals are horn-that physically, there is a distinct criminal type. The majority of criminologists deny thus

The scientist will tell you, moreover, that the composite photo is not always to be trusted. But the composite pictures on page 47 certainly seems to indicate distinct types of evildoers, and what you read in each face corresponds to characteristica attributed to the various classes both by the celebrated Lombroso and by New York detectives who claim to be able to spot a criminal by bis features.

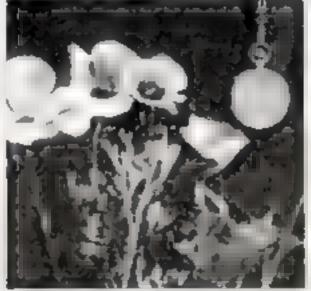
Note, for instance, the determined energy and intelligence in the gale-burgiar's face; the apparent degeneracy in the murderer's. and the seemingly refined traits of the counterfeiter



How Flowers Turn Their Faces to Follow the Sun



California poppies photographed at 10.30 a.m., turning their blossoms toward the east



The same poppies at high moon. The blessoms have opened, face upward



At 3:30 p.m. Craning their necks toward the west, and closing their petals for the day

Handsome Traffic Tower for Fifth Avenue Unveiled

IN ORDER that New York City's traffic towers may be artistically attractive, the Fifth Avenue Association has presented to the city seven artistic bronze towers, to be crected along the famous avenue

The first of these, recently unveiled at Forty-Second Street, contains a bronse bell weighing 350 pounds that tolk out the hours to the burrying crowds below

All towers along the avenue operate simultaneously, permitting traffic to cross the street for two minutes, then allowing a five-minute interval for travel along the avenue. Colored lights in the top of the tower indicate to drivers and pedestrians the direction of travel at any instant.

The World's Largest Automatic Sprayer

AN ENTIRELY new method of irrigating large tracts of land has been developed recently in France by E. Rolland, who has invented the largest automatic sprayer in the world. Mounted on wheels that run on rails along a steel bridgeliks apan, the huge aprayer automatically distributes the water evenly over a given surface as it moves back and forth.

In the first demonstration of his invention, Rolland has constructed arrive the center of a large truck garden plot, a steel true framework, the top of which is approximately 12 feet from the ground level. This framework, supported at latervals by piles resting in concrete blocks, serves to carry rath on which the apparatus runs. The steel structure also supports a trough or conduit that carries the water for spraying, as well as the water turbine that supplies power to run the apparatus.

The spracing apparatus itself consists of a long sees frame suspended from a four wheelest track that rank on the rank at the top of the true (ramework. At each safe of the apparent frame, which is hard at right

angles to the trust, are long condults from which, at various intervals, the water apouts from nozzles. The truck carries this apparatus at an even speed, automatically reversing and returning when the end of the truck is reached

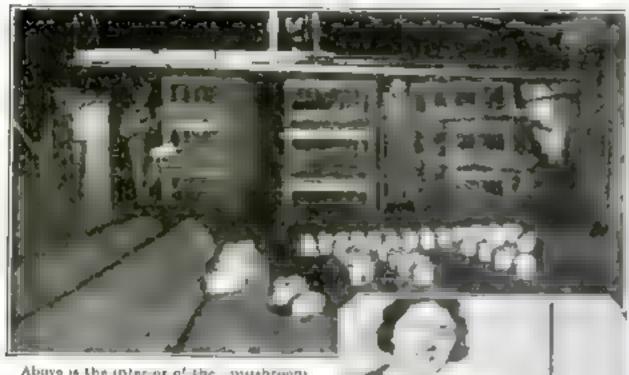
The truck is operated by a water turbine stationed at one end of the frame trusswock. The power is transmitted through pulleys arranged so that either forward or reverse motion is obtained. As the sprayer proceeds along the track, it draws water from the trough above it by means of a siphon. Stopcocks regulate the flow, and the turbine is operated by the force of the water

This method is said to be superior to ditch traination, requiring one manual labor and distributing the water more evenly.



Above is the steel trum on which runs the huge automatic sprayer seen in the distance. Note turbine connected with water supply in the foreground. Inset shows how aprayer is suspended from trolley running on rails

Tiny Thunderbolts Help Mushrooms Grow



Abuve is the interior of the mushroom ranch where as it at growing methods produce the prized forg. The mushroom but shown at right weight seven pounds and is 51 inches in circumterious.

property of a dramatical manager of a developed hy A. G. Hapfel, Jr. of New York C tv. With such a commission of at citalants, Hupfel class he can grow mushrooms above ground a well as in the colours of cayes where they are usually raised.

Since mushrooms are paramites, lacking the chlorophyl or green substance of other plants, they cannot assumilate air and water necessary for growth, but must depend on other plants to manufacture their organic food. For this reason they require especially prepared beds containing organic food at the correct temperature

Hupfel's mushroom farm is located in a dismantled New York brewery. Water for the beds is supplied by artificial fog produced by passing steam from the old brewery boiler through refrigerating apparatus. Fog is greated this way about twice a week

Breathing, like esting, is difficult for



Net Safeguards Riveters

AS A protection for riveters engaged in arceting a steel standp.pe at Carthage N Y., a "circus net" safety device attached to the brackets that support the scaffolding, has been developed by C. W Penrod foremen of the Chicago Bridge and Iron Works.

Should a workman slip from the narrow scaffold and fall, the net would eatch him and save him from certain death.

mushrooms. To help them breathe, Hupiel has installed static machines that produce sparks of electricity, releasing oxygen from the air in the same manner that lightning finshes do. The static generators, he says, have a decided effect on the crops, explaining why wild mushrooms grow best during thunderstorms

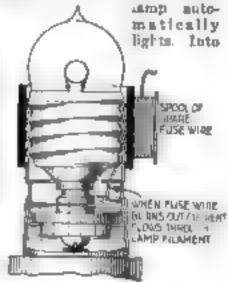
The "jazz music" process of stimulating mushroom growth remains a secret with its inventor. It consuts of a mechanism that produces a constant drumming nuise to which the plants are said to respond. The constant agitation is supposed to increase the formation of paint ceils and consequently the amount of organic matter.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Pilot Light Flashes if

THE examperating labor of testing electric light fuse plugs in a large panel to determine which fuse has hurned out has been eliminated by the invention of a renewable plug with small pilot lamp attached. When the fuse burns out, the

When this plug is in use, the pilot light is short circuited by the fune; but when the fune burns out, electric current flows through the lamp fils-



a plug of the ordinary type the inventor, C. F P Carrier, of Philadelphia, Pa., has inserted a socket that holds the pilot lamp.

Ordinarily current passes from the center contact through the fuse to the sleeve, and



the lamp common unlighted because the fine short circuits the filament. When, however, the fune is broken, this short circuit is removed and the current pames through the lamp filament.

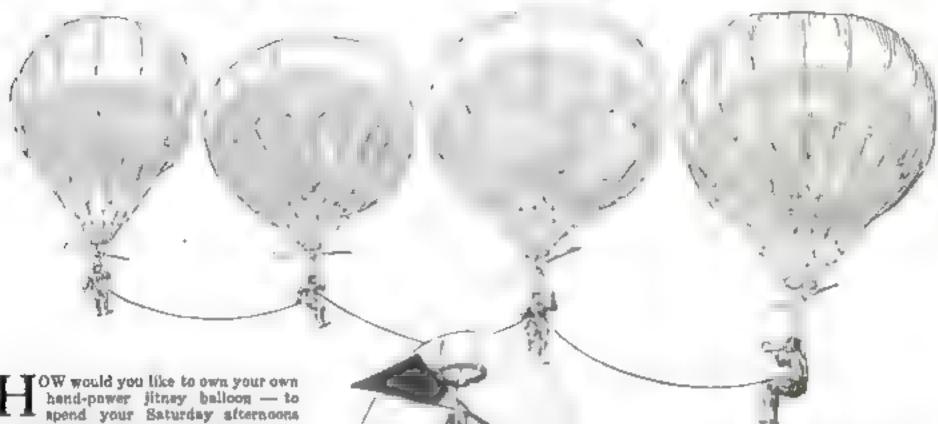
When the fuse burns out, the lamp is removed, and a short length of fuse, unwound from a spool of spare fuse wire at the side of the plug, is strung from a knob in the bottom of the plug upward into the lamp socket

How to Carry Fishhooks on Your Hat

Mand fishermen who
have had sad
experiences
with fishhoom
will welcome an
ingenious book
holder, consisting of a spring
coiled about a
wire that can
be attached to
an old felt hat.
The hooks are
caught over
this spring.



The Jumping Balloon—Thrilling New Sky Sport



hend-power jitney balloon — to apend your Saturday afternoons joy-riding in the sky, up a thousand feet or so, swinging beneath the round belly of a small gas-filled bag and traveling anywhere you can induce the playful breezes to take you?

You sit in a suspender-like harness slung from ropes. In your hands you grasp a atout pulley rope. You give a streasous tug on the rope just ske pulling an old fashioned elevator cable. A small hore nontal propeller whire just above your head -and up you go, jumping into the sky 100 feet at a jump!

You Need Not Be an Expert

Here's a new sport that you can't beat anywhere for thrills and for the exhimating exercise of skill and muscle, if you take the word of those who have tried it. The hand-propedled "jumping balloon" in the recent invention of M. Q. Corbett, W. E. Hoffman, and C. F. Adams, of the army "lighter than alr" squad at McCook Field, Dayton, Ohio. And the best part of it is that you don't have to be an expert to sail it. A schoolboy or even a sober husiness man whose feet have never left earth can safely handle the jumping sky jitney.

Why? Because you can control the ups and downs of the gas-filled bag simply by pulling a rope that whirls a propeller. You don't need a load of ballast to throw of when you want to secend, and you don't need to let gus out of the bag when you want to come down. All you need in healthy muscle power to whirl a propeller feat enough to produce a five-pound thrust, up or down, equivalent to five pounds of ballast or a lifting force of 70 cubic feet of

Where Skill Adds to Sport

But you may acquire skill in judging air currents, and making use of them to travel where you want to go. And that is where the chief sport comes in-a sport that, balloonists ted us, is more fescinating than any other sport in the world.

The new jumping balloon has beld an altitude of 1000 feet for 40 minutes and has landed from 3000 feet without the use of ballast. It has made a flight of six hours' duration, with five landings and five changes of pilote, two of whom never before handled a balloon, and it has jumped as high as 150 feet in one jump.

Horizontal propeller and pilot's harness are slung rom the gas bag. shown above. By hauling on a pulley cope, the pilot whirle the propeller. producing an up or down. Urrest that taken the place of ballast or gas valve as needed

Weighing only 50 pounds the entire outfit can be carried in a bundle small enough to pile into an automobile



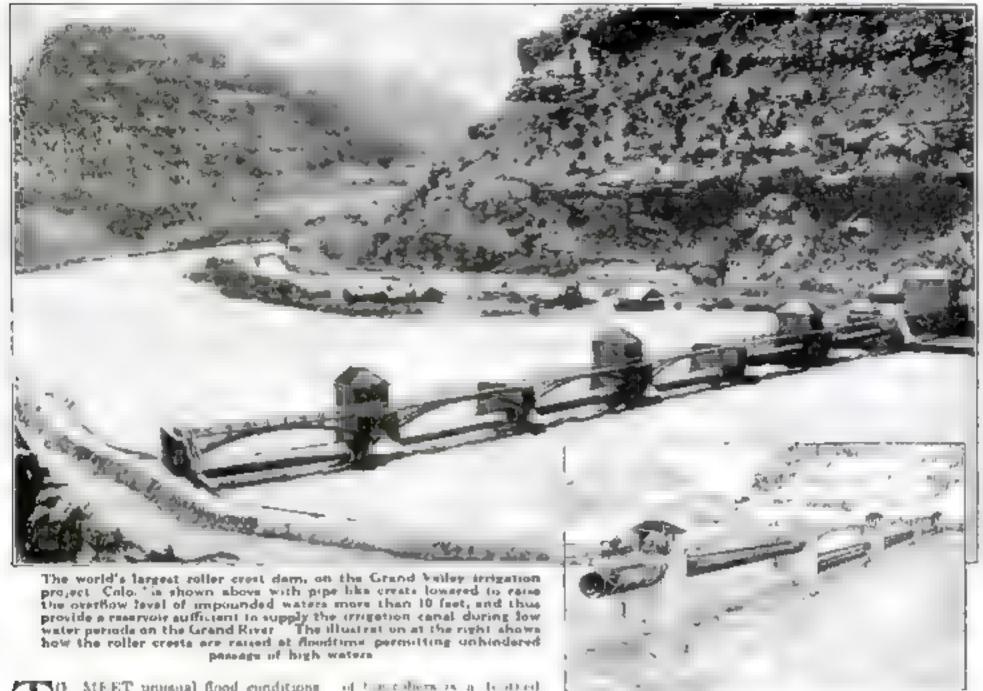
Up she goes! Too gas-filled bag of the sumping balloon of single-ply rubberized fabric, is capable of lifting a 160-pound man, as proved in this actual test at the McCook Aviation Field. Dayton, Ohio, where the invention had its first tryout

How a party of jumping balloonists can sail

off together on a sky excursion. Such an arrangement in fact, was the chief purpose

of the inventors to be used in training students of bellooning by roping their ships to an instructor's craft

Crest of 500-Foot Dam Lifted Clear of Floods



In impounding the waters of the Grand River, Colo., United States engineers in charge of the Grand Valley irrigation project have constructed the world's largest roller crest dam—a huge bridge-like structure 545 feet long, supporting seven pipe-like sections, or roller crests, which can be raised and lowered to regulate the level of overflow, and thus the height of water above the dam

During the greater portion of the year, the amount of water in the Grand River bed is very small and consequently every possible amount must be conserved. The river, however, is subject to violent floods and if there were no means of cutting down the maximum height of the dam at such times, railroad tracks parallel to the river bed would be flooded. Thus it was necessary to construct a dam the height of which could be changed at will.

Largest Roller Dam Ever Built

Roller crest dame have been used extensively in Germany and Austria for some time and two others have been constructed in this country, but none is of the magnitude of the one built in Colorado. The dam proper consists of a concrete weir resting on gravel. Supported on piers above this dam are the roller crests—bollow steel cylinders 74 feet nine inches long and seven feet 1% inches in diameter. To each of these cylinders is attached a curved apron shield of ateel which, when the creat is down, rests on the sill of the dam, forming a seal.

Ends of the roller creats project into receases in the piers and roll on smooth tracks embedded in these recesses at an angle of 20 degrees with the vertical. Around each end rim engaging a toothed

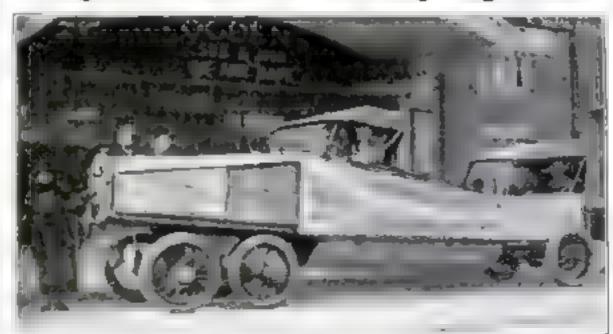
rack fixed parallel to the track. The rollers are raised or lowered by means of a chain, one end of which is fastened about the roller, partly encircling it. The other end is wound about a dram in the hoist house surmounting the pier

When the rollers are lowered, with the curved shield extension resting on the concrete dam, the height of the dam is increased 10 feet three inches, holding back sufficient water in the dry season to furnish a steady flow through the irrigation canal

With the rollers raised, and the height of the dam decreased, flood waters pass under the rollers, without endangering the dam or the raisroad tracks that run at the side of the stream.

In order to construct a cofferdam, a pile bridge was needed. Overriding many difficulties, the superintendent of construction succeeded in getting the bridge built. A heavy flood came down almost as soon as the bridge was built, but fortunately it withstood the strain

Elongated Auto Is Moving Signboard



Designed to attract attention to advertisements on its sides, this elongated, six-wheeled auto is being operated profitably by a woman in Jersey City, N. J.

After three years of experiment, Dr. E. H. Armstrong,

inventor of the novel crank-

less engine shown below.

has produced a revolutionary automobile power plant

New Crankless Auto Engine Saves Power and Wear

REPLACING the usual automobile crankshaft with a floating disk, or "wabble plate," against which the pistons drive with direct horizontal motion, a new crankless engine recently tested by the Massachusetts Institute of Technology, has been given a rating of 75 per cent efficiency. 15 per cent higher than the most efficient gasoline engine of the present day

A Recolutionary Power Plant

In operation, the engine has actually drives an automobile more than 5000 miles without requiring attention.

Representing throe years' work by Dr. E. H. Armstrong, C. W. Clements, and three other inventors, and the expenditure of more than a quarter of a midlon dollars, the invention is said to represent a revolutionary departure in power plant design. These men claim for their engine:

Greater power with far less fuel consumption.

The elimination of 150 parts now used in the

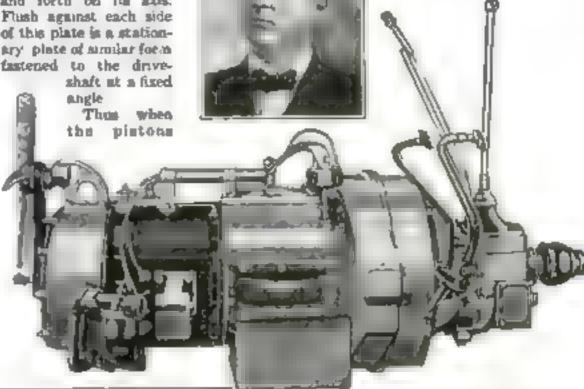
average automobile engine

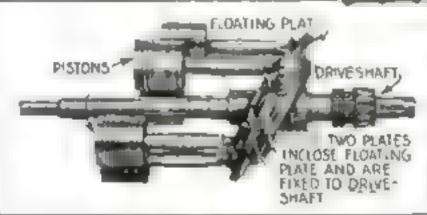
Extremely low cost of production and low upkeep cost

In the ordinary gasoline engine, the piaton

connecting rod at its full downward thrust against the crankshaft, is approximately 37 degrees out of sine, creating a tremendous ade thrust on the cylinder walls, traveling a wasteful distance, and causing a loss of power. By substituting the floating plate, the power thrust of the pistoes is delivered with a direct, horizontal gnotion, and transmitted directly to circular plates fixed to the drive-shaft.

In the engine five cylinders surround a stationary shaft to which they are parallel. From these cylinders five connecting rods extend to a circular floating plate with which they are connected by ball-and-socket joints. The center of this plate is attached to the shaft through a ball-and-socket joint, so that while it cannot rotate, it can talt back and forth on its axis. Flush against each side of this plate is a stationary plate of armiar form fastened to the drive-





The above diagram shows how Doctor Armstrong has replaced the usual crankshalt with a tilled floating plate against which five pietone exert direct, hor-laontal thrusts. Oscillations of this plate rotate two adjacent tilted plates fixed to the drive-shaft

push against the outer edges of the floating plate, the thrust causes the two stationary plates to rotate and turn the drive-shaft. The five pistons exert their push in rotation, thus producing a steady flow of power on the driveshaft and distributing the wear over the entire surface of each ball and ancket

The eventors believe the engine is admirably suited for use in military airplanes because of the fact that the straight shaft could be made bollow, rifled like a gun harrel, and cooled by the motor cooling system

Surgeons Save Life of Huge Python

BY PERFORMING two operations within two weeks—probably the first attempt to apply surgery on such a scale to the treatment of reptiles—surgeons recently saved the life of a valuable python transported from India to Long Beach, Calif.

The python is 29 4 feet long, weight 280 pounds, and is nearly 100 years old.

While being removed from the ship, the reptile's neck was caught on a spike and badly torn.

A veterinarian having been called in, a mustle was placed over the snake's head, and the 14-inch wound was sewed up with alk thread. When the wound did not heal satisfactorily after 10 days, it was recoved with alver were.



Surgeons stitching a 14-inch wound in neck of 200-pound python.



Metal Paper Clasp Finds Many Office Uses

A METAL paper clasp, designed to hold from two to 100 sheets, thus climinating the necessity of keeping in stock several sizes of clasps, has recently been placed on the market by a concern in Cleveland. Ohio.

When booked over the edge of a deak, the clasp can be used to prevent loose papers from being blown about. It can be used also to retain loose sheets on the inside of book and ledger covers.

Small Glass "Bomb" Serves as Fire Extinguisher

ABOUT 90 per cent of the annual fire hom might be prevented, experts say, if it were possible always to have at hand a means of immediately extinguishing the flames. A simple new appliance for this purpose is in the form of a bulb resembling



How bulb extinguisher hangs in bracket

a targe electric lamp, filled with a fire amothering liquid. The bulb rests in a wall bracket.

If a fire starts, it is necessary only to hurl the bulb into the flames. A partial vacuum above the liquid in the bulb causes an inrush of air when the bulb breaks, scattering the liquid and smothering the fire quickly.

Light, Sturdy Boats Built of Concrete



Concrete rowbest formed by plastering coment mixture over mold of wire much

A CONCRETE rowboat is the latest achievement of T. A. Brouwer, of Westhampton, N. Y., whose hollow concrete statues were described in the January issue of POPULAR SCIENCE MONTREY.

In constructing the boat, he built a hollow mold of rough lumber, over which he stretched were mesh as a base for the concrete. Over the mesh he plastered the cement mixture to a thickness of one half inch. The inventor claims, however, that a shell of one quarter inch thickness provides sufficient strength for the average rowboat.

The novel craft is said to compare favorably in weight with a wooden boat, with resiliency sufficient to withstand ordinary shocks; moreover, it can be cheaply and quickly built.

Chain Conveyors Sort Lumber by Length

A LUMBER handling machine equipped with conveying chains and brackets that elevate the lumber, sort it into various lengths, and finally energy it to the places where it is to be used, is saving much hand

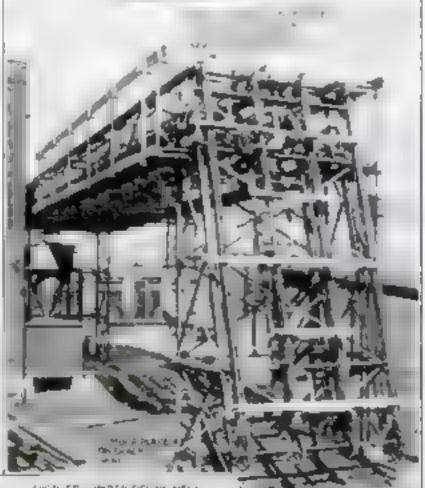
work and trucking to a fo ory at Ningara Fals

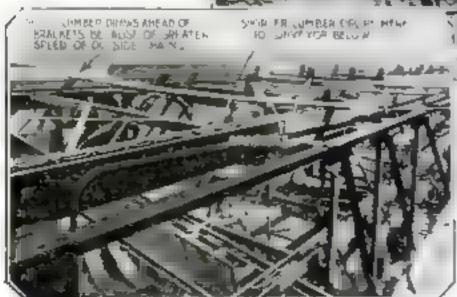
The mechanism melitics three conveyor systems. One is an elevator; a second carries short pieces of lumber and a third is for long pieces. In the elevator are four paralle, chains moving on sprocket wheels. Projecting from the two inner chains are brackets on which lumber of various lengths is placed piece by piece.

When the lumber reaches the top of the elevator and begins to travel horizontally, the two inner chains are depressed so that all lumber that is shorter than the distance between the outer chains is carried at an elevation three inches lower than that of the longer pieces traveling on the enter

China rus.

Arriving at the upper sprocket wheels of the elavator, the short pieces drop to the short piece conveyor, while the long pieces continue their journey on the outer chains to the third conveyor





Above The elevating conveyor, showing him long pieces of lumber rest on outer chains and shorter pieces on enier chains. At left Where lumber is surted, the short pieces dropping from the inner conveying chains to a conveyor below, while lunger pieces continue on their way



Filing Machine Sharpens Saws Automatically

MECHANICAL naw filing has been a problem for inventors for some time and in consequence much interest attaches to the recent invention of a saw filing machine which the designer, H. B. Foley, of Minneapolis, Minn., claims performs the operation as satisfactorily as hand work

The mechanism has four moving partsa horizontal moving carrier, which holds the file; a vertically moving guide frame in which the horizontal carrier slides; a fly or hand wheel for propulsion, and a regulating cars.

A standard file is mounted upon the horizontal carrier and its pressure against the saw teeth is maintained by two small springs. The file is then moved across the saw by the action of the guide frame moved by the rotation of the handwheel. After the completion of a stroke, the cam cases the file, which is returned to its original position and is again lowered upon the saw by the same care.

After a definite number of file strokes, the saw moves forward automatically in accordance with the setting of an adjusting screw. This screw governs feed pawis that engage in the saw teeth and move the saw forward after a definite number of file atrokes.

The vertical guide such can be fastened at any angle for making any angular cut. When the teeth have been filed on one side, the naw is reversed.

My Greatest Discovery in Fifty Years

Famous Plant Wizard, Celebrating Half a Century of Useful Labor, Tells How He Believes We Can Develop Better "Human Plants"

By Luther Burbank, Sc.D., Especially written for POPULAR SCIENCE MONTHLY

N THE seventh day of March, I was 74 years of age. On that day, I celebrated the conclusion of half a century of ceaseless experimentation with plant life.

In those 50 years, miltions of plants-grasses, flowers, vegetables, grams, and trees—have passed through my hends, and from them I have selected a few, seemingly a very, very few, for preservation, reproduction, improvement, development, to such a point that they may render the utmost service of food, beauty, and enjoyment to man.

Plants Teach Man

To me, they have become like a rast group of individnais, marching onward, guided by selection, toward a goal of improvement. From my first creation-a potato that is now grown by the millions of bushels all over the habitable globe-to the latest of more than a dozen varieties of new and commercially valuable fruits-of which more than 100 cartoads were shipped last year from California alone -there has been growing

stead ly within my axperience the belief that in the development of the plant lies a great, if not the greatest, object tenson for human beinge

That benef has grown in 50 years to a

The Grand Old Man at 74

"QMOOTH so ask feel it!" Here to America a grand old man of plant breeding Luther Burbank as he appears today at the age of 74, testing against his wrinkled cheek the amouthness of the spincless cucumber one of the many remarkable creations of his half century of wyorks. On the occasion of Colombia superintation of his liftieth year of labor. H shank has witten the accompanying arolly for Populan

fact. It has been proved time on time, and I have crystallized it into two statements, one the corollary of the other.

First, that plants are pliable and under the control of man; and that they can be bred and trained and developed, just as entmals can be bred and improved and trained.

Second, that the human plant-the child-can be trained, developed, and improved, Just as the skilled gardener, or the trained botanist, trains, develops, and improves the best that is in plants.

The Hope of Progress

During the course of many years of investigation into the plant life of the world, creating new forms, modifying old ones, adapting others to new connections, and blending still others, I have been impressed constantly with the similarity between the organization and development of plant and human Lie. While I have never lost sight of the principle

of the survival of the fittest, as an explanation of the development and progress of plant life, I have come to find in the crowing of species and in selection wisely directed, a great and powerful instrument for the transformation of the vegetable kingdom along lines that lead constantly

The crossing of species to me is para-I pon it, wisely directed, and

accompanied by rigid selection of the best, and as rigid on exclusion of the poorest, rests the hope of all progress.

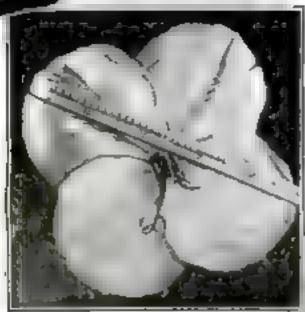
In my work with plants and flowers, I introduce color here. abape there, size or perfume, according to the product desired. In such processes the teachings of Nature are followed: its great forces only are emproyed. All that has been done for plants and flowers by natural crossing, Nature already has accomplished for the American people. By the crossing of types, in



spinoless cactus, at right A wild, spined

cactus is thuwn above

The spineless cactus, which Burbank considers one of his most valuable discoveries, because it "converts waste lands into pustures capable of support-



More than five inches in diameter, the wooderful Burban's evening printrose above was developed by careful selection from wild evening primroses of California, such as those shown at the right

one instance, strongth has been secured: in another, intellectuality; in still another, moral force. Natura alone has done this. But the work of man's bead and hands has not yet been summoned to prescribe for the development of a race. So far, a preconceived and mapped-out crossing of bloods finds no place in the making of peoples and nations. But, when Nature has already done its duty, and the crossing leaves a product that in the rough displays the best human attributes, all that is left to be done falls to selective environment.

In my life work, when two different plants have been crossed, that is only the beginning. It is only one step, however important; the great work lies beyond in the care, the nurture, the influence of surroundings, selection, the separation of the best from the poorest; all of which are embraced in the words I have applied—selective environment.

Just an all plant life is sensitive to environment, so is all animal life. And of all living things the child is the most sensitive Burroundings act upon the child as the outside world acts upon the plate in the camers. A child is the most susceptible thing in the world to influence, and, if that force be applied rightly and constantly when the child is in its most receptive condition, the effect will be pronounced, immediate, and permanent.

The Child a Human Plant

We should begin with the child where I begin with the plant, at the very beginning. It has been and that "the way to reform a man is to begin with his grandfather;" but this is only a half truth, for, while it is true that we should "begin with his grandfather," we should begin with that grandfather when he himself is a child.

The secret of the successful results of my work with plants has been partly in my love for plants. If you are cultivating a plant, developing it into something finer and nobler, you must love it, not hate it; be gentle with it, not absolve; be firm, never harsh. I give the plants upon which I am at work the best possible environment. So it should be with the child, if you wish to develop it along right ways. Let it have music, pictures, laughter, and a good time; not an idle time, but one full of cheerful occupations. Plants should be given sun

and sir, blue sky, and proper nourishment. Give them to your boys and girls.

Choose what improvement you wish in a flower, a fruit, or a tree, and by crossing, selection, cultivation, and persistence, you can fix this desirable tract irrevocably Pick out any trait you want is your normal child, he it honesty, fairness, purity, lovableness, industry, thrift, what not. By surrounding this child with sunshine from the sky and from your own heart, by giving him the closest communion with nature, by feeding him well balanced, nutritious

food, by giving all that is implied in "healthful environment influences," you can thus cultivate in the child all of these traits, and fix them for all his life.

These are the most important discoveries,

certainly the most valuable, that I have made in my half century of selecting, training, developing. and improving the members of the vegetable kingdom. 1 n that time, I have passed through a million interesting experiences, not least of which has been to watch the development, through years of experimentation, of productive, useful plants from forms that before had been comparatively worthlean. have looked down upon a minulate forest of 240,000 plum meedlings, of as many distinct varieties, from which I was to make a selection, right here in my own grounds, of ONE TREE. which, in turn, was to produce a plum that ripened rapidly. packed well, shipped well, and sold well in the market.

I have had the

pleasure of developing a chestnut—a tree that normally requires from 15 to 20 years to come into full bearing—into a tree that bears nuts at six months from the planting of the seed nut, and is in full bearing at two years.

From the small, hard, bitter quince I have developed, by selection and crossing, a fruit larger than the largest apple, juicy and sweet when enten raw, and as fine in flavor as the most delicious apple when baked. There is nothing in that quince except the best qualities of the original

quince, but it has been given encouragement and opportunity to develop to its utmost, and it has responded, just as any other plant, animal, or child will respond and develop if so cared for

I have taken the slow growing, small, hard-shelled wild black welout and, by crossing it with the softwooded, soft-shelled, edible walnut, produced a tree with a finer, harder wood than the black walnut, yet which grows many times as rapidly as the latter and produces better and more nuts.

Prune Trees from Almonds

Prom the crossing, selection, and development of young trees of the common prune within the past 40 years, I have developed a larger, sweeter, earlier fruit, which dries better, ships better, keeps better, and selis better. I recall one time, back in 1881, when Warren Dutton, a friend of mine, came to me in March for 20,000 prune trees, to be ready for setting out that some year. This meant the planting, and growing to a height of from two to five feet, of

20,000 prune trees within nine months. I took the contract, and this is what was done

Twenty-five thousand almonds were spread over a bed of well-drained creek sand, and covered with a thickness of



This giant artichoke, 14 inches in diameter nearly four feet in circumference, developed from smaller variaties with which we are familiar—is one of many marvelous new plant creations announced for this spring by Luther Burbank



To help the poultry raiser, Burbank created these dwarf sunflower plants, greatly shortening the stalk of the usual apecies and turning the blossoms face downward, so that poultry may help themselves to the seeds

hurlap, over which was laid an inch of sand, kept moist. The almond seeds had the proper environment and the best of care. In two weeks they were aprouting. One by one, as they sprouted, they were set out in rows, four inches apart.

In June, when they were a foot or more high—still being almonds, mind you, while I wanted prants—I obtained from a neighboring prune orchard, 25,000 prune buds, employed a budding crew of 15 men, and inserted the prune buds in the almond needlings. Prune shoots appeared from the buds, the tops of the almond trees were cut away, and I had, not quite 20,000, but about 19,800 young prune trees, ready for delivery, and ready on time. They made an orchard of more than 200 acres, and, though that bit of work was done nearly 42 years ago, all of them are still growing and bearing abundantly.

Man Can "Go Noture One Better"

It is all so simple; life in every form is so clear; it is all a process of evolution. And man, by perseverance, patience, watchfulness, study, care and love, may aid im-

measurably in the processes of that evolution. He may accomplish in 10 years what Nature takes 10 centuries to do.

For more than half a century I have had one definite object—the improvement of the vegetable kingdom for the benefit of man. Deciding first, exactly what I wish to create, I begin by selecting the strongest, best developed plants of that variety available. They come to seed, the best seed from them is planted again, and again developed for further selection and planting; cross fertilisation by pollen is carried on, and so the work continues until the ultimate product of that particular parent stock is reached. There is nothing supernatural, nothing mysterious about it. It is a work into which I gladly, joyously put my beart and mind and hands.

Just now, I am trying to produce better grains, nuts, fruits, and vegetables, so well as larger, more beautiful, and more fragrant flowers, striving not only for new forms, colors, and sizes, but for those products of the vegetable kingdom that will provide more food and tens waste

On my experimental farms, more than 2500 experiments are being conducted. I

shall have ready, the spring, a variety of new grains, seed-bearing grasses, quitable for both forage plants and for grain crops, and others for cereals; new walnuts, huge, rapid-growing hardwood trees, which will produce more valuable lumber in 10 years than the new well-known varieties will in 50 or 100 years; a drought-resisting lipping for lawns in dry regions; a new asparagus, which is to the ordinary variety as the Burbank potate was to its predecemors; an artichoke, the blossom of which is four feet or more in circumference; and a number of new climbing vince and flowers.

Burbank Promises Future Marvels

Among the new blossom-bearing plants I shall offer soon, are immense larkspure, both annual and perennial; new stanias, larger and brighter than any before known; new petumas and a verbena with much larger flowers and a pleasing odor. There are to follow, within a year or so, still more interesting and valuable productions from the work of selection, development and improvement that I have been doing in the plant world for the last half century.

Floating Seaplane Dock for Ocean Airline Way Station

A RECENT development in the project to establah transationtic commercial air service, comes in the form of a new seaplans dock, built by the British air service

The difficulty of anchoring such way stations has been overcome theoretically by the invention of a deep sea anchor by E. R. Armstrong, of Wilmington, Del., described a year ago in Popular Science Montely. By anchoring a series of



The anchored dock, showing scaplane high and dry on wharf. A series of these docks is proposed for transatiantic flights

three docks in a line from America to Europe, using heavy deep sea unchors, it will be possible for planes to crom the Atlantic in a number of short jumps.

In this way plants would not need to carry excess weight, for they could procure additional fuel at the way stations. The danger of a long if ght over water would be materially reduced, for service ships plying between stations could and any plants in distress.

Scoop Trowel Saves Time in Bricklaying

AS AN improvement in the science of brick, sying which has remained practically unchanged for many centuries, Oscar F. Mann, of Induspolis, Ind., has invented a trowel which, it is claimed, will enable the bricklayer to lay from two to four times the usual number of bricks.

The trawel is in reality a scoop with sloping sides and a projecting point. In use, the implement is first moistened by dipping in a pail of water, then filled with very wet morter. By inverting the trawel and drawing it along a row of bricks, the bricklayer is able to distribute the morter very evenly over the surface at exactly the correct thickness to receive the next layer of bricks.

An advantageous way to use this trowel is for the bricklayer's assistant to spread the mortar, while the bricklayer binne f lays and points up the succeeding rows. In this way one man may become very proficient in laying mortar, while the other becomes expert in laying bricks, incidentally economizing on time.

Scaly Ant Eater Rolls Up in Its Tail

At the approach of denger, this strange longtailed ant-ester from Central Africa wraps itself up in its tail to form a bell, as shown below. The animal then rolls away from the danger spot. Note the armor-plate scales that protect the entire body when rolled up



IN A remarkable collection of strange animals brought from the wilds of Central Africa by Seth Thomas, explorer for the London Zoological Society, is an extraordinarily long-tailed ant-eater, called "pangolin," that rolls up in its tail like a ball whenever an enemy approaches,

This litard-shaped animal is covered from head to tip of tail with hard scales that appear to be of bone, but that on closer examination prove to be made up of closely woven have all tightly joined together. These scales serve as stiff armor which, when the pangolin rolls itself into a ball, covers all exposed parts of the body. Strange to say, while the animal is in the form of a ball, it is able to roll itself along

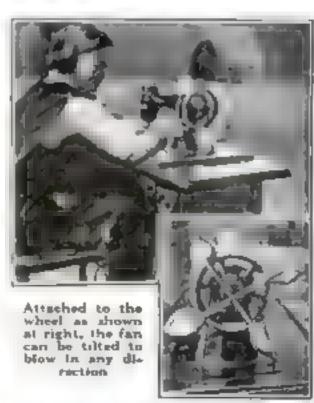
the ground, and thus move away from the scene of danger.

Long claws, attached to the pangulin's short legs, also serve as effective weapons for defense. In running or walking, the claws double up under the feet. For this reason the pangulin panally stays in its hurrow in the daytime and hunts by night.

Of the several species of pangolin, of which the long-tailed type is one. all have the charp claws and long, sticky tongue of the ant-enter. They are usually from one to three feet long. The pangolin has no teeth; instead, the mouth contains a bony structure that extends into the throat. On the talls of some varieties are bare spots, verving a purpose unknown to scientista.

Dwarf Orange Tree as a House Plant





Sewing Machine Runs Fan

ATTACHED to the flywheel of a sawing machine a novel rotary fan has been perfected by a manufacturer in Atlanta, Ga., to keep the seamstreen cool.

The fau, which has four blades tilted to throw the air in the direction of the operator, is arranged so that it can be sprung easily into the wheel to rotate with it.

Will Gyroscopic Wheel Shatter Speed Records?

OWN the track of a motor speedway a wheel 14 feet high whirls at such a dizzy speed that racing automobiles traveling at top speed 115 miles an hour-seem almost to stand at II. So fast cioes the giant wheel travel that the details of its design can scarcely be distinguished

This is a possibility prophesied by Prof. E. J. Christie, of Marion, Ohio, for an amazing gyroscopic untcycle of his laven-

tion, now being constructed in Philadelphia, Pa. The 2400pound 14-foot mode. of the speed wheel is almost ready for a trial spin and Christie confidently predicts that it will develop a speed of at least 250, and possibly 400 miles an hour!

design, the l n strange vehicle repembles a glant blcyels wheel with an exceptionally long hub, at the end of which supporting spokes are fastened. Attached to the axle, on each aide of the center are 600-pound gyroscopes designed to rutate at

a speed of 90 revolutions a minute in speed sufficient to maintain equalibries

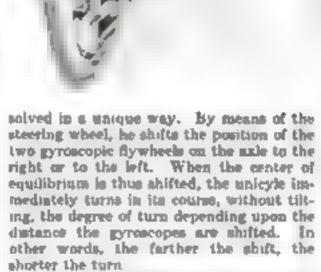
Suppended from the axle by a frame the upper end of which supports the driver's seat, is a 250-horsepower simplant mot a the power of which is transmitted to the mule through a friction clutch, three-speed transmission, and jackshaft. An additional chain drive in the center of the axle connests the ungine transmission with the кугонсорея.

The machine is controlled and operated like an automobile from the operator's sest immed stely above the axie. Here the driver is saved from swinging about the axle by the steadying weight of the engine along below.

How can such a strange vehicle be turned?" you may ask

This problem Professor Christie has

pictured by its inventor Prof E. J Christie, as whirling user a speedway course at 400 ms les an hour, fleshing past the speedsest PACINE CAPA

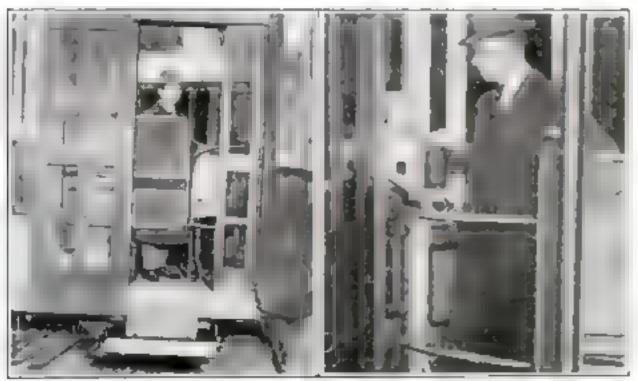


The wheel is supplied with a seven-inch

rubber tire, the manufacture of which proved a problem in itself. Pressure resistance was found to be so great that several attempts were made before a strong enough tire was produced.

The new gyroscopic unleyels is not the first machine of its kind Professor Christie has produced, although it is by far the most pretentious. He first used a gyroscope to demonstrate the rotation and momentum of the earth

Automatic Conductor Makes Change on Pay-as-You-Leave Car



At the exit, a turnstile opens when nickel is deposited

The high-speed change-making

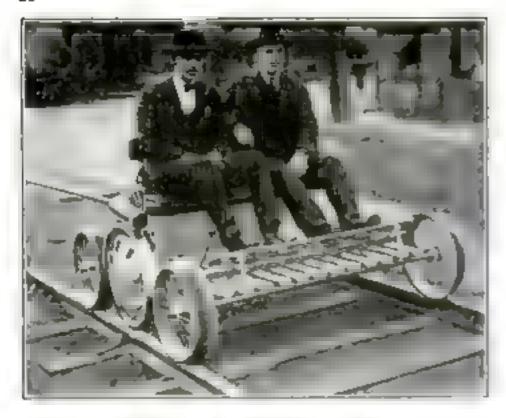
machine supplies exact change

PAY-AS-YOU-LEAVE trolley car, equipped with an automatic cashier and turnstile, has made its appearance in New York City. Passengers entering pass through a turnstile, which registers the number of occupants in the ear at any time. A high speed automatic change making machine is located Just inside of the entrance door and supplies the passengers with exact change, a nickel being always part of the change returned.

Turnstile Keeps Record of Fares

Before leaving the car, passengers must pass through another turnstile which operates only when a nickel has been inserted in a slot. By moving in one direction when a person enters, and in the opposite direction when one goes out, the turnstile keeps a record of the number of passengers in the car at any time.

When the car's capacity is reached, an automatic sign on the roof displays the word "Full."



Power Wheel Drives Handcar

THE small, trailing wheel engine attachment for breyeles, which gaves so much of the cyclest's energy, has found a new application as an attachment for railway inspection cars. The auxiliary wheel is attached to the side of the car and runs on the top of the rail, transmitting its power through rubber tires.

Cranks Plane from Cockpit

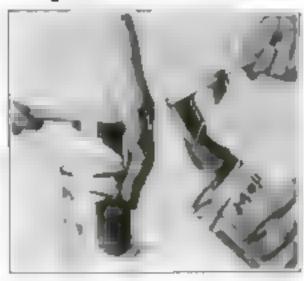
IN PRONT of the pilot's seat in the first metal simplane to be completed in the United States in a horizontally turning crank that enables the aviator to grank the mutor without leaving the cockpit.

The plane has been constructed for the Navy Department and has made successful trial flights at Martin Field, Cleveland, Ohlo.

Single Slashing Cut Opens Tin Cans

A READY means of opening cans of preserves is provided by a new can opener, which cuts a circular six almost entirely around the top of the tin when forced down by pressure with the pairs of the hand.

Into the first handle of the instrument is cast a cylindrical blade that has been cut at an angle to form a sharp point in front. The entire edge of the blade is sharpened, so that whom the point is placed near the edge of the can top and pressure is applied, the cylinder makes a circular inclaion, leaving only a small section of uncut tin, which serves as a hinge when the cut top is raised



Handy Pocket Case for Micrometer Caliper

TO MANY ongineers and mechanina. the small interometer caliper in an instrument that must be constantly within reach yet carofully protected from dust and dirt. For this reason a tool manufacturer of Providence, R.1., has turned out a



New the caliper fits anugly into convenient case

caliper case, resembling an eyeglass case, so small that it can be carried conveniently in the pocket.

The case, lined with plush and covered with leather, has been designed to form a practical and efficient receptacle for this delicate instrument

Scientists Produce World's Shortest Radio Waves

ESTABLISHING further proof of the theory that light, heat, and electric waves are identical in character, Dm. E. P. Nichola and J. D. Tear, of the Nela Research Laboratories, Cleveland, Ohlo, recently announced that they have produced electric, or radio waves only one fiftieth of an inch long. These are the shortest known radio waves, and are identical in length with the longest heat waves.

This achievement, accomplished with the aid of instruments more sensitive than herotolors available, marks the joining of the electric wave and heat wave spectra. In the experiments two types of electric wave receivers were used to detect and remeasure the long heat waves, about one third of a millimeter in length, that were obtained by two scientists, Rubens and Von Baeyer, in 1911

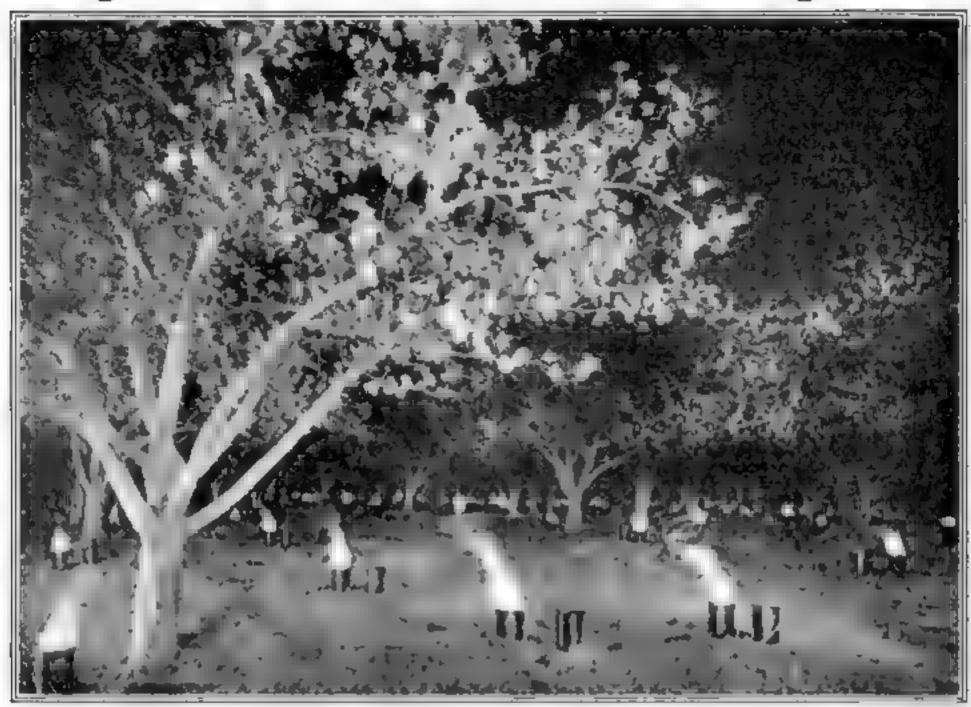
Ordinary radio transmission is by electric waves measuring from 200 meters (nearly 700 feet) to 15,000 meters (about 10 miles).

Novel Electric Signals for Tramway



Using a pole to short circuit transvey wires up the Pitt River power project, Calif , the transcer operator signals the engineer to raise the ear

Gong Alarms and Oil Burners Rout Killing Frosts



O P. C. Innetman

This remarkable nighttime photograph of a blossoming Colorado apple archard shows how flaming out burners are used to protect trees from killing frost. From 25 to 50 of these burners are used to the acre

ODERN science is at last achieving victory over one of the most deadly and destructive peace enemies he knows—Jack Frost

For centuries man has had to stand by, helplessly witnessing the spectacle of his carefully numed crops falling before the silent onelaught of early spring frosts. Often a killing frost would creep upon a garden or orchard without warning while the farmer slept—and the next morning he would watch his valuable crop wilt under the rays of a warm sun

Now, however, the actentific farmer can go to bed knowing that a gong will ring and waken him if Juck Frost is about to make a visit. That warning is sent out by thousands of electrically connected thermometers that ring a gong when the thermometer drops to a danger point.

Night Riders of Pacific Coast

Another system now in vogue on the Pacific Coast in the use of night riders men who patrol sarge districts and inspect government tested thermometers. Some of these districts embrace 30 or 40 square miles, with as many as seven routes, 500 telephones, and 126 thermometers. Each rider reports his readings to headquarters, from where general alarms are sent out on the approach of a killing frost

As soon as the farmer is warned of frost, either by electric thermometers or by the night rider, he sets out to fight frost with heat. Although several kinds of fuel are used for artificial heating, the modern automatic feed oil burner has proved most effective, except in localities where there is a large accessible supply of wood. Many Oregon farmers have saved their crops by burning old stumps and rails, thus protecting exchards that produce \$1000 worth of apples an acre later in the season

Oil Burners in Great Favor

But the oil burner is finding increasing use. The Colorado or Troutman heater, developed by P. H. Troutman of Canon City, is being used in every state in the Union. This heater with an oil capacity as high as six gallons, has a center tube or chimney that creates a draft and aids perfect combustion. It is made in three sections. A lower section forms the reservoir, a center or combustion chamber is fitted with a rim with a short apron, and at the top is a large cover. Increased heat as high as 50 or 60 degrees is obtained by removing the rim or collar, while still greater heat is obtained by removing the cover

In many large orchards heaters of this type have successfully brought delicate blossoms through severe frosts without damage, from 25 to 60 heaters being used to the acre. Smaller heaters, equipped with attachments that deflect the heat in any direction desired are used to protect strawberries, raspberries, and other small fruits and vegetables.

Frust occurs whenever the mercury drops to 32 degrees or lower. This drop con-

denses and freezes particles of moisture on plants and creates what is known as "white front." If no water from the air is condensed, the result is a "black frost." A permanent freeze results from low temperature accompanied by high winds.

During the day, the earth receives more heat than it can throw off. Continually the heat that the earth discharges rises to colder layers of air above, and the colder air flows down, to be warmed in its turn. At night the earth's heat supply is shut off, yet it continues to pass out heat from its reserve supply, and as a result the colder air continues to pour in at the surface. In spring and fall this air sometimes becomes cold enough to cause a frost, especially after a rainy period when the earth has little heat saved up.

Putting Heat in the "Bank"

The most common way of keeping the earth from giving away its heat in to furnish it with a heat "savings bank". Glass a just such a "bank," for it allows the heat from the sun to pass through to the earth, but will not allow the radiated heat from the earth to pass back. Glass, however, is expensive and cannot be used on large areas. Wood, while it does not allow the sun's rays to pass through, is used in the South to cover crops.

Paper, although less efficient, is often used for the same purpose. Some grops, especially cranbernes, are saved from frost by fooding the field with water

Huge Steel Viaduct Moved Bodily for 75 Feet

HE amening feat of moving sidewise, for a distance of 75 feet, an entire steel viaduct 740 feet long and 150 feet high (at its highest point) without interrupting foot traffic across it, was recently accomplished by a Pittsburgh engineering firm. The seemingly impossible task was completed in 14 hours of actual work, although nearly six weeks were required for preparations.

When first the fensibility of moving Jacks Run Bridge, near Pittsburgh, Pa., was considered, one angineer expressed the benef that the bridge could be moved if the rusted steel floor were immediately reinforced. This was done and work preparatory to moving the bridge began. although several engineers prophesied fail-

Bridge Travels on Rollers

Concrete piers and earth-filled timber abutments were erected at the spot chosen for the new location of the bridge-75 feet away from its original location. Along the path over which the bridge was to move, cribbing was laid, and on this cribbing steel rails were placed to serve as a track on which the bridge could travel. Next, heavy Lbearns were boited to the pedestal stones. of the bridge and, when these were jacked up, the heavy foundation stones beneath were broken up and removed. Then, beams and timbers were inserted under the pedestal cap stones in such a way that they rested on steel rollers designed to move along the track. This was done at each of 15 pairs of supports.

When all was ready, workmen were stationed at each support of the bridge to operate the jacks that would move it forward. Each time a whistle blew, each jack was moved five quarter turns. At two of the supports, the jacks fell out and yet the



work went on without them. Many people walked across the bridge as it was being moved.

When the structure had reached its new location, rollers and I-beams were replaced Above a section of the 740-foot Jacks Run Bridge before it was moved aidewise 75 feet to its new location, as in-At left How bridge supports, resting on rollers, ween moved armultaneously along tracks. At a whistle signal, each lack was endeed five quarter turns

by brick and concrete four-nations for the

In just 26 hours after the actual moving started, trolley cars were running across the bridge in its new location

An idea of the tremendous task involved may be gained from the fact that 100 truckloads of equipment, 300 jack screws, 400 etest rollers, a mile of raitroad rails, 150,000 feet of timber and 100 tons of steel 1-beams were required.

Dazzling Speed Shown in Linemen's Race



HREE teams, each composed of two linement and a belper, competed recently in a unique wiring efficiency test staged in Baltimore, Md.

Each team cut gains, or notches, in a pole, erected a cross-arm, hoisted a transformer into place, installed primary fuses, strung secondary wires from transfermer to conduit, and connected, soldered, and taped all joints.

The winning team's time in completing the job was 15 minutes and 10 seconds.

Vitamine Products Tested and Found Wanting

THOROUGH investigation of special products claimed to be high in content of vitamines has been made by the Connecticut Agricultural Experiment Station with the result that of 25 samples agamined, only two were found to be se effective as ordinary brewer's yeast,

The exact chemical nature of vitamines is, at present, somewhat apeculative, but experiments tend to show that lack of these food factors causes serious undernutrition in the human body, as well as duesaes.

In the recent investigations, rats were brought to a subnormal condition by being fed a diet lacking in vitamine B, and then were fed the products claumed to be high in vitamine content. For purposes of comparison, the same rate were fed ordinary brewer's yeast later. The rate showed a decided increase in weight after being fed the brewer's yeast, but failed in all but two cases to respond to the so-called vitamine products. It was even found in some cases that rate fed the commercial "vitamines" became ill of diseases caused by a lack of such vitamines. Two foreign and 22 domestic products were examined.

The Connecticut Experiment Station has suggested as a remedial measure that socalled "vitamine" products be considered as patent medicines and be made to con-

form to the same standards.

Floating Mooring Mast Proposed as Way Station for Airships



O Popular Science Publishing Co., Inc.

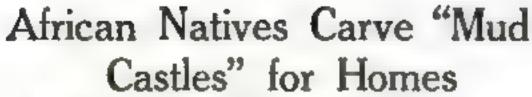
ONVINCED that buttle fleets of the future will require the aid of rigid stratupe as long range scouts, acronautic experts recently have suggested an ingenious method of mooring rigids to the must of a moving depot ship at sea, as pictured above.

The depot ship, preferably a converted

cruiser, has a hangar forward for small fighting planes, with a launching dock from which the planes are seen taking off to protect the rigid as it returns from a trip.

Topping a raised tripod most is a mooring device to which the airship is anchored. while projecting from each side of the vessel are other tripods carrying guide ropes that hold the arrship's how in position as its none cone is hauled down to the mooring device.

Immediately behind the mooring must is stretched a wire curtain to prevent planes from overrunning the great landing deck seen projecting above the boiler smoke ducts aft. Above this curtain is network to catch the mooring ropes when cast loose.





Over a domed framework of slander wooden poles the soud is plastered and dried in the sun

IN KIRDI-MASSA, on the west coset of Africa, you mustn't copy the design of another man's mud house. The offense is punishable by death

The houses sook like hage antilis, with only an ineconstropening for a door the side and a small round chimney hole at the top to admit light and sir. The design on the outside is often e absorate and worked out with the greatest pains, for it serves to identify the owner of the hat,

and is virtually "copyrighted" by him.
The native builds his home of a staff clay much like the adobe used by Mexicans.

and Indiana. This is poured over a framework of slender whose indirect was a more tased as relifered to a sure that a sure that a most tool whee the mad is most.

mud home. For ventuation, the law

arched dourway faces prevailing winds

The stoor, seldem large enough to admit a man standing erect, does not always reach to the ground. Rinco it usually faces the provailing a non, enasing a constant curtent of air to move through the but, and made the thick mud

walls keep out the heat of the sun, the interior is fairly cool, even during the terrifically hot summer months.

This design worked on an "anthill" house, corver as a family trade mark. To copy it means "vendetta" and death

Midget Electric Lamp Is Clamped to any Tool

A MINIATURE flash lamp, so small that it can be clamped to the index finger or to a wrench, has been designed especially for use in tinkering around the automobils at night. The lamp is connected with a pocket battery, or it may derive its current from any electric light socket



Clamped to wrench, this featherweight lamp throws light where needed

Lens Detects Bogus Coins in Subway

THE days when fron slugs and Chinese tacks could safely operate the turnitiles of the New York subways is past, for the treeelt company has recently equipped the coin boxes controling the turnstiles with leases that magnify the coins to twice the size of a silver dollar. Thus makes it possible for inspectors to detect spurious coins at a distance of 15 feet from the ma-

When the transit company discovered that more than one per cent of the passengers were using all

manner of cheap substances (r 1). Les causing an annual loss of \$200 000, the mechanical detector was installed. Regularly appointed inspectors now closely watch the

magnifying lenses.

When a nickel is dropped in the slot relessing a catch that holds the turnstile of is grasped by two arms that carry it interesstion in the rear of the lens. Light from an electric lamp is reflected upon the cosmilluminating it sufficiently to bring out the highly magnified details of the surface of bold relief, and thus expose any fake.

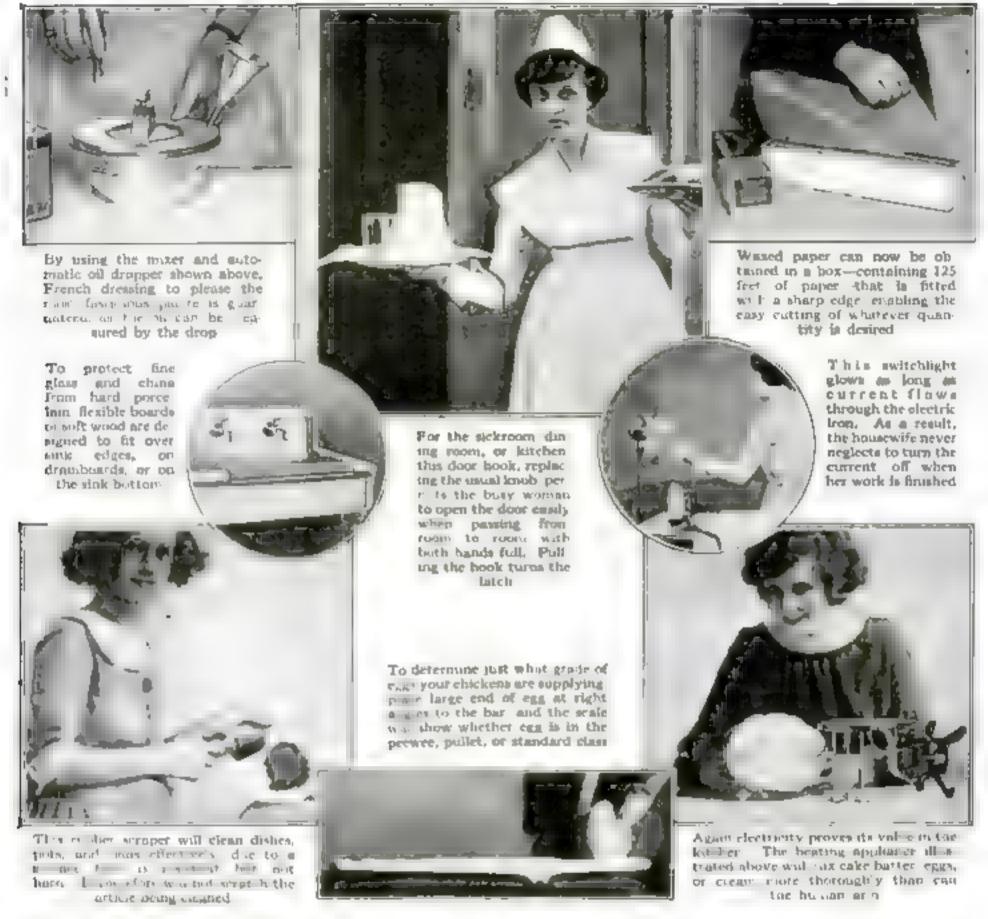


How come are magnified and all immated for inspection as they are dropped into turnatile cam boxes by subway passengers. Upper iffustration shows how the detector reveals a Chinese coin At right, five cent piece, showing Indian boad design





Better Kitchen Methods for Modern Housewives



Combination Garden Tool Has Five Interchangeable Blades



The combination garden tool, showing five reversible and later-changeable blades for use in raking, bosing, cultivating, weeding, sidewalk trenching, and a wide variety of jobs about the lawn and garden. Note how the blade is attached to handle by universal joint, parasitting easiest adjustment of handle

NEWLY invented garden and lawn tool with five reversible and interchangeable blades and combining 18 different cutting edges, may be used as garden rake, hoe, thinning tool, sidewalk tranching tool, weeder, hand cultivator, or soil

pulveriser

The universal ball-and-socket joint by which the various blades are attached to the handle, makes possible an adjustment of the handle in any direction up to 50 degrees from the vertical, considering the blade as a horizontal plane. The adjustment is accomplished by placing the foot on the blade, turning the handle one half turn to the left, thereby loosening the balland-socket joint and then, by turning the handle buck to the right, fastening it.

Changing the blades is accomplished by removing one screw, placing in the desired

blade and replacing the screw

When used for cultivation, the sawtooth blades leave the surface soil in an exceptionally satisfactory condition.

How Uncle Sam Fights Menace of Dust Explosions

THE appalling loss of life and property resulting from half a dozen coal mine explosion disasters since the ending of the nation-wide coal atrike last year has spurred Uncle Sam's officials to redouble their efforts to eliminate the bazard of dust explosion—a danger that continually confronts \$1,000 industrial plants in the United States manufacturing products valued at nearly \$7,000 000,000 annually.

Where Dust Peril Lurks

This menace of inflammable dust, as dangerous as dynamite, powder, or gasoline, is present chiefly in coal mines, grain elevators, and flour mills.

In determining the exact causes of dust explosions in coal mines and discovering means of prevention, the government's most effective agency has been an experi-

mental mine at Bruceton, Pa., where a series of 600 explosion tests have been conducted

by the Bureau of Mines.

Until six recent mine explosions killed 185 workmen and injured 150 others, these experiments had succeeded in cutting down loss of life to a marked degree. A certain degree of laxity at the mines following the strike is given by the Bureau of Mines, as probable reasons for the sudden increase to distanters. Ductuming these distanters. Dr. H. Foster Bain, director of the bureau says

"While one man may ignite firedamp by smoking or opening a selety lamp, or may cause an explosion by firing a dangerous shot, the broadcasting of three explosions through the mine is due invariably to the presence of cost dust. Such spreading of explosions by cost dust can be presented."

The most spectacular of the government

"WE MUST regard dust, even the kind used to kill insects, on an explosive at dangerous as dynamits or gasoline."—David J. Price, United States Department of Agriculture.



tests to determine what types of explosives may be safely employed in coal mines is produced by an ingenious apparatus, pictured on this page, which literally fires a charge of high explosive from a cannon into a long, dust-laden steel tube. This steel gallery, about six feet in diameter, is fitted with manholes at the top and observation windows at one side. On the inside walks are shelves on which coal dust is placed. One end of the pipe is closed.

When the gallery has been filled with a mixture of gas, coal dust, and air at normal temperature, a charge from a cannon is fired into the gallery, while observers watch

To set the explosive quality of goal door and goal, a carnon charged with a carnon charged with a carnon charged with a carnot be to be to be the first part at the first sea how the proper of an explosion in tested by containing a second carnon rate a 3 felt panel mortar, who heats as a pendagung

its effects. If the extremes is to be caused as "permuside," the charge should not ignite the gas of the coal dust

In a strong test the force of the car not a cut in it deceated against a large pendaum anigning 31 500 pounds and comes ing of the barrel of an old count art ters must at the power of the exp. save is determined by the swing of the pendulum.

As a means of preventing the spread of coal dust, the bureau advises either one of two methods: To wet the dust thoroughly so that no dry dust remains in the mine, or to dilute the coal dust with other non-in-flammable dusts, uch as shale or limestone.

SPARKS of static electricity, such as are caused by rubbing a cat's fur the wrong way or abuffing across a carpet on a dry, wintry day, may cause explosion eccidents.

Spectacular Test Proves Resistance of Fireproof Paint

THAT paint can be prepared in such a way as to act as a fire resistant, protecting buildings to which it is appued was demonstrated in a spectacular test recently conducted before the Fire Preven-

tion Bureau of Chicago.

Three unal buildings, constructed of ordinary inflammable pine, were placed 4 feet spart directly facing a strong westerly wind. One was painted with the best grade interior mill white paint, another with a paint supposed to be fire resistant, and the third with a fireproof paint



Surrounded by burning shavings, the central building, coated with newly invented fire-resistive paint, remained standing after buildings at each side had been destroyed

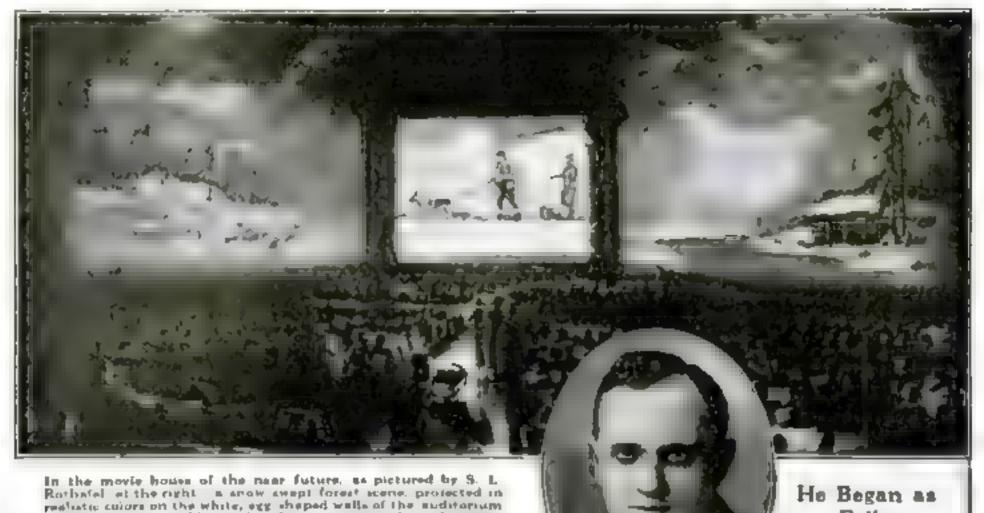
recently perfected by a Western manufacturer. The buildings were surrounded with wood shavings saturated with gasoline.

Twenty minutes after the match was applied only the third building coated with the new fireproof paint, was left standing

There are a number of pa nin county prepared by the home owner — that add greatly to the fire resisting qualities of a building. One cheap and effective method in to introduce powdered asbestos into the paint.

Famous Manager Predicts Egg-Shaped Playhouses

Plans to Paint Movie Theater Sets on Walls with Light



FIR to a car grain when we shall

as shown above, would provide a dramatic setting for a philtopiay

By sete to the good eneroght parting which and to deal to each to each man and at the same and the same ported to a vivid and of drama, where pulled not not concern, life aprings from the very walk of the theater in which we set. While the drama and is not to as we saw to present assed to ever obtaining waves of a sea, payment as a same and the same and

he choses and from the range

the star from \$ 1 Both affects of the transfer of the transfer

these meas we had remained by Rothsfel, we'd have an agest performance with bare walls. He describes it as follows

"Entering the theater, we are carned by escala-

tors to an upper floor, where we find curselves in a vest auditorium scating 5000 persons. Instead of claborate architectural decorations, the walls of the egg-shaped auditorium are bare and white. But as the lights go down, we are suddenly flooded with colored light from a thousand rethe total a very hadder in
the war a chem as a he pery
remest to place the war a cont
a from any appeared have
become a very be a grig rab
orne in a forest a sea a grea a to
each in turn painted on the war a by
colored light projectors above

"While we are thus earlied in our images of the second of

5 2000 8 F 805 Z Frat to being pool The state of the s age of the state o THE REPORT WHEN BUT IN an an entropy range of many may make a first plants on an arms on In forms, pressure to a mention The first of the spring of w sero s he wast to the offer of the figure as frontage of but a few optit will allow the entire leaver thoor to be used as a store The audience will enter from the rear and leave by the front, saving endless confusion. The

the state of the factor

painting of walls with changing scenes by light would not only mark an advance from a standpoint of beauty, but it would actually be an econ-

"Ten thousand scenes could be painted every year for far less than the decoration of the walls would cost. Light painting ONCE a failure at tempted, S. L. Rothurel to-day in managing director of

the world a greatest movie thu

n er and racka an obe of the tenlorement motion perfore geniuses of America just occause he fratted how to make use of his sen built and youther) adress such as se presents

Rother of segan his movie career in a makeshill hearer tigged up be and a barroom in a Panneylvin a mining town senting his sents to in the andertaker. There he conceived the alea of twilight projection of conton pictures to school the projection of theater auditor one. As a result he was selected to manage in large theater in Mawauker Wis Later he assumed that go of the Regent 5s and Rivol Risko, and finally he Capitol theaters in New York City.

DE CONTRACTOR DE

Diagram of the proposed ogg-shaped theatre, showing assis-less making arrangement and method of projecting semic effects on the walls

work lot on pass to if course to at the careful to a series to the first of and the careful to a series of a series and more can be a series to de that a cheater if any other shape could provide

'At if these things mu, of he accomplished. But I can speak with somely when I say that new of them amonabled p. W. L. is a completion in the new future.

Fuel Oil from Coal

AS A method of supplementing the diminishing petroleum supply of the country. Charles R. Fettke, associate professor of geology at Carnegie Institute, proposes the low temperature carbonisation of enormous quantities of bituminous coal now being burned for steam producing purposes.

He declares that the process will not only recover many valuable by-products, but will product an oil fuel superior to that of two coal and abate the smoke numeroe.

Photographic Road Map Shows Landmarks to Guide Tourists

THE problem of adequately guiding the automobile tourist traversing unfamiliar roads has been solved by the practical mind of E. C. Gamble, engineer, of Portland, Ore. With the aid of Portland business men, Gamble is producing an automobile guide book that includes not only a map showing accurately every mile of road of a given route, but also opposite the map, photographs of landmarks at intervals of every mile of the road.

Gamble first tried out the plan in the state of Oregon, carefully mapping the roads and taking photographs at one-mile intervals. The pictorial road guide was so successful that he then began the tremendous task of mapping and photographing the road from New York to Portland. He has now completed this work and the pictorial zoad guide and chart map will be usued at

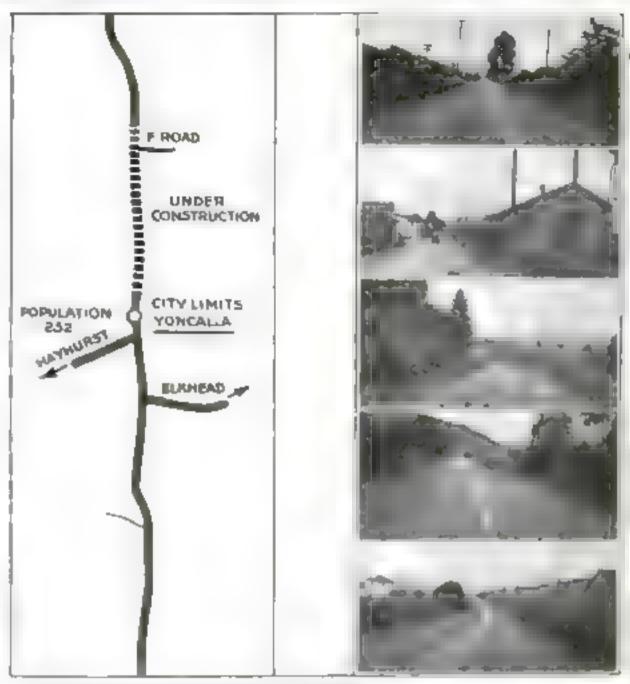
an early date.

Supplementing the Map

Instead of using an ordinary road map, Gamble personally charted the entire distance, supplementing the chart of the road with explanatory notes such as "railroad," "bridge," "garage," "telephone," "view-point," and other information likely to be required by the tour at.

It is difficult for a motorist to get lost with this guide, for should be not find the bend, landmark, or scene pictured in his book at the end of each mile, he would immediately know he was on the wrong road

The Editor will be glad to supply, wherever possible, names and addresses of manufacturers of devices mentioned in this issue.



This section of the new guide for automobilists shows map of an Oregon road at left, and opposits, photographs of landmarks along the road

Truck Searchlights Aid Fire Fighters

DOWERFUL searchlights mounted on a apecial fire truck and playing on the walks of a burning factory building in Brooklyn, N. Y., recently aided firemen in fighting a terrific blaze and in rescuing dozens of men and women trapped in the upper floors

The gweep of the flames was so rapid that escape from the upper floors was quickly cut off Workers clung in terror to the fire escapes or flung themselves from windown. By the food of light feam two powerful larges the firemen were guided in the work of rescue.



New Shakeless Sait Cellar Works with Plunger

PLUGGED
holes in the
salt order need
no longer run
our dispositions
since the invention of a shakeless salt container

By pressing a plunger, a small valve underneath the container is unseated and a small amount of salt occapes. A apring returns plunger to place.



Pressure on the plunger releases sait from this little container

Quick Turn at High Speed Is Peril for Air Racer

PLANS for this year's Pulitzer Prize zero race brought out the fact that the human system cannot withstand the strain of a turn in the air in which centrifugal force is greater than four times gravity, because the heart is unable to force based to the brain against this force.

According to Communder Jerome Hunsacker, naval flier, a violent turn of 90 degrees at a speed of 200 miles an hour causes a centrifugal force of about three times the force of gravity

Scientist Discovers Why Carbon Hardens Steel



In these huge flaming suidrens, known as Bessemer converters, molten pig lean is steel hardened by diffusing carbon in the correct proportions. Carried on cars from the smelter, the molten metal is poured into the cup-shaped vessels fined with clay and mounted on pirots. Here silicon, manganese, phos-phorus, and carbon are removed from the metal and carbon

is later replaced. In the bottoms of the vessels are openings through which air is forced, after passing through the hollow pirots. Bubbling up through the melten metal, this air supplies the engree which unites with the undesirable chemicals, forming immense sprays of telered flatting gases that are blawn out through openings in the top of the vessels

HILE steel has been hardened industrially for many years by the introduction of carbon into the molten metal during the manufacturing process, the causes and nature of this phenomenon have been disputed questions until recently, when researches by Dr. Zay Jeffries and R. S. Archer, of Cleveland, Ohio, developed a theory that has enabled metallurgista to determine to a mathematical certainty what processes should be used in producing the desired degrees of bardness in steel.

The "slip interference" theory, as it is known professionally, holds that particles of steel, when under stress due to an ex-

ternal force, tend to flow or slids against each other along definite planes unless locked in place by particles of another element, carbon. When carbon is scattered through the metal, it forms innumerable little anchors that must be torn loose before the metal can slip. How these particles should be diffused in the metal to produce strength is explained in the accompanying diagram.

One of the methods of introducing carbon in the proper proportions is by means of the Bessemer converter, pictured at the top of the page.

By observing the color of the

fames emerging from the mouths of the converter caldrons, akilled workmen can determine the state of the liquid metal.

In obtaining the proper carbon content two methods are followed. One of these is

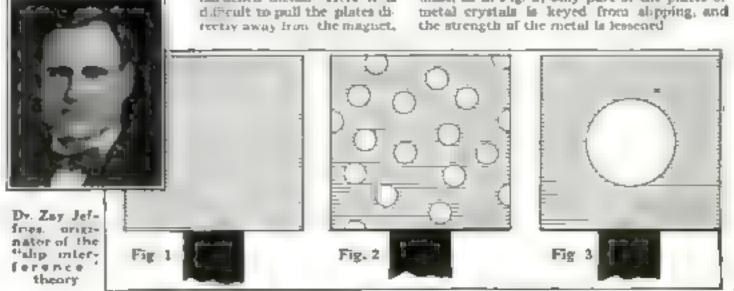
to stop the process when observation indicates approximately the correct carbon. content. The second method is to hurn out all the carbon and then recarbunge the metal to the desired extent.

How Carbon "Balls" Lock Slipping Metal Crystals

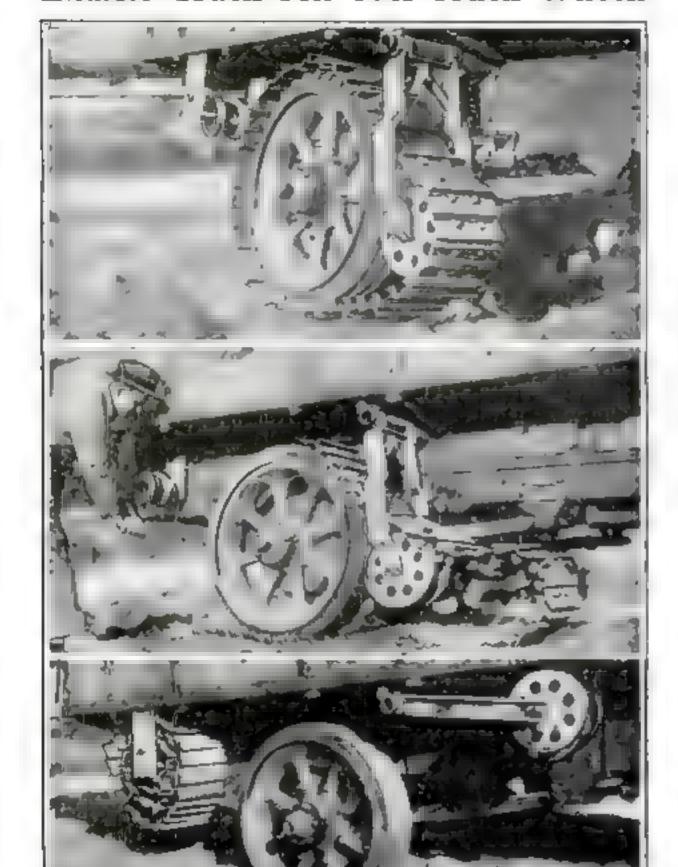
THE diagram below illustrates Dr Zay Jeffries" "alip interference" theory of hardening metal by the introduction of carbon. Assuming that the failure of metal takes place along slip planes when crystal particles of metal slip one over the other, consider a piece of steel as a lot of from plates piled on top of a magnet, as shown in each figure below-

Figure 1 represents unhardened metal. Here it is difficult to pull the plater dibut it in many to alide them of sidewine. When the strain on the metal is too great, the crystals slide away until a break occurs.

Figure 2 illustrates the diffusion of carbon particles through the metal, like a lot of balls inserted within the plates, so that each ball keys several plates and prevents them from slapping. This represents properly hardened metal. If the carbon balls gather in a large touse, as in Fig. 3, only part of the plates or



Endless Track Fits over Truck Wheels



Charle we the Containing of Schools

Top: Complete track unit in position. Note position of idler, swinging against wheel. Center: Pulling track over wheel and idler. Bottom: Track relied up and idler swang out of the way

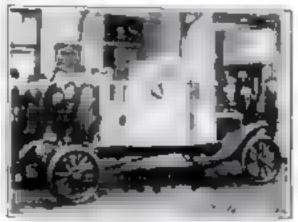
Safety Sign Rights Itself if Knocked Over

LTHOUGH knock over one the safety signs used about a factory at Moline, Ill., the danton Iliw toma reg remain un marked, for the nga in provided with a heavy cup shaped base that will draw the sign into its erect position if thrown over on its side.



Locknut Auto Advertises Shock Absorbers

SHOCK absorbers for a light car have been successfully advertised by building the body of a car in the form of a huge locknut. The idea that the firm seem to



The body forms a huge lecknut

put across is that its improved shock absorber reduces vibration and prevents the nuts on the car from being shaken off

Electric lights on the corners of the body illuminate the advertising matter pointed on the sides, and projecting wooden bands direct the attention to the shock absorbers.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of davices mantioned in POPULAR SCIENCE MONTHLY.

A REMOVABLE continuous tread track that may be adjusted to any standard motor truck in 10 minutes for operation over solt ground, has been invented by C. F. Ball, of Santa Ana, Calif When not in use, the track is awang high up under the track and out of the way

The track is similar to that used on endless trend tractors, and is equipped with a device for joining the ends when in operation. An intermediate idler, mounted adjustably on a crank arm and running against the truck tire, holds the track in a position to insure proper tension

A trank reel mounted on the truck back of the rear wheal serves not only as a hanger to hold the track when not in use, but also as a pulley in adjusting the track over the wheel and idler. The idler, when not in use, also swings out of the way under the truck.

The drive is by friction from the tire, producing a maximum speed of 20 miles an hour.

Autos Parked on Roof of Building



Do You Know How to Overhaul Your Car for Summer Touring?

Auto Expert Tells Fine Points of Spring Housecleaning

By Harold F. Blanchard

AVE you done your spring automobile overhauling?

Perhaps not yet. But if you value your car, if time means money and pleasure to you, and if you wish to be saved needless expense, you must certainly plan a complete overhauling, just as the housewife plans her spring house cleaning. If you are an average motorist, your car receives the very hardest kind of service during the winter, when it pounds over roads roughened with mud, lee, and snow, and when the mechanism is continually expensed to the ravages of cold and moisture

Be Your Own Car Doctor

You are probably looking forward to several thousand miles of motoring (for business or piessure) this year. If so, and if you think of your car as a loyal friend, you will plan to give it the advantage of a thorough going over in order to repair the damage winter has done and put the car in tune for summer

But do you know how to inspect your own car? Do you know just how to overhaul it, tune it, and make the whole an harmonious place of mechanism? If you are an average motorist, probably you do not; and so I am going to outline in detail here the important steps necessary to put your car in condition for summer, just as I explained last fall what should be done when winter comes.

First, let's see how winter affects your automobile. What parts are most exposed to effects of loy blasts and rough usage?

The answer is easy—Springs. Tires.

By far the most important item in overhauling your car is to find out whether there are any broken or cracked leaves in your springs. Wash off the sides of the springs with kerosene and examine each leaf for its full length. Like a small cut in a tire, a single broken leaf is a weak spot that must be watched; for one broken leaf means that other leaves in the spring will eventually break.

Watch Out for Tire Cuts

The next step is to examine the tires for cuts. If you find any of importance, fill them with tire compound. Large cuts

should be vulcanhed

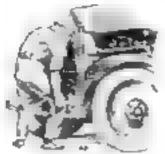
Third, have your battery examined by an expert. If you have been running your ear infrequently, the chances are that the battery is run down and perhaps also sulphated. If you have been calling on your car for much use, the battery may have been damaged by overcharging on long drives. In any case, it will pay you to see that it is in good shape before you start your summer motoring.

You can never count on a battery. Some batteries will last for years. Others will give out in a few months. I know one motorist who bought a new battery last spring. During the summer months he covered several thousand miles alternating between long and short trips. In the late

The "Fourteen Points" of Car Testing



1 Drive car to determine whether valves must be ground and carbon removed. If car has a tendency to knock when throttle is opened, and the noise is not due to spark being advanced too far, then carbon removal is probably required. A carbon knock and a spark knock are similar in sound



2—If the engine lacks power and runs irregularly, especially at low speed, the valves may need grinding. To make sure, crank the engine over slowly by hand with all petcocks open, except on the cylinder being tested. If some or all cylinders show poor compression, valve grinding is required.

3 — Examine tires for cuts. Deep cuts should be vulcanized and leaser ones filled with tread repair compound.

4-Clean and adjust spark plugs



5. Test specific gravity of each battery cell. Cells in good condition should read from 1 280 to 1 300; those below 1 300 are discharged or defection. 6—Loose connecting rod bearing is usually indicated by hammering when engine is decelerated or when idling. Loose main bearing pounds most with wide throttle

7—Examine starter and generator brushes for wear and commutator for amouthness



6—Determine play in drive mechanism by placing lever in high gear and jacking up one rear wheel. If play measured on the wheel rim is more than an inch, call on competent repairman

9—Go over all wiring tightening connections, and replacing badly insulated wires



19—Jack up each wheel and shake it to determine whether the bearing requires adjusting. If play is more than one sixteenth inch, the bearing should be adjusted. Be careful not to confuse wear in the kingpins of the front wheels with play in the bearings

11 Look at breaker mechanism. Smooth and adjust points if they are rough or pitted

12-Adjust brakes. Reline if lining is worn out



13. If play in steering wheel is more than an unch at the rim, it should be remedied. Note proportion of play in various parts 14—Check tightness of fan belt abo tightness of hose connections, and pump glands



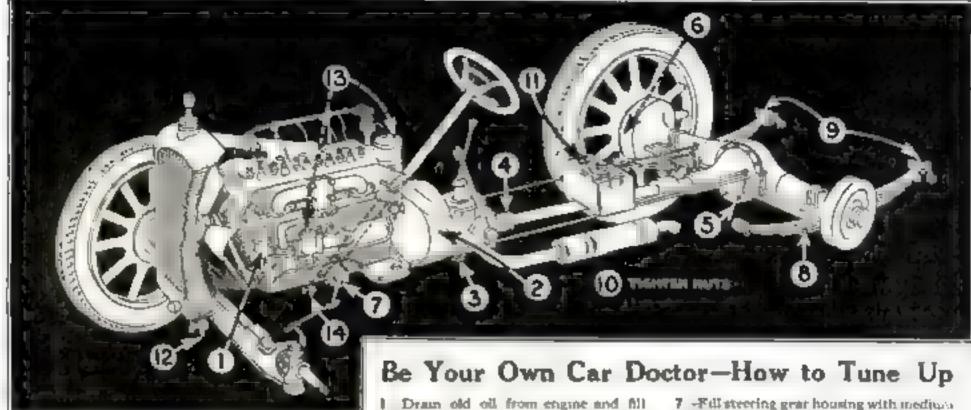
fall the battery began to show weakness and finally became so bad that it was necessary to crank the engine by hand.

His decision to have the battery rebuilt disclosed the fact that most of his trouble came from one weak cell. Whenever the battery was thoroughly charged, two cells would be normal—that is, they would have an electrolyte with a specific gravity of 1.275—while the third cell was weak (it could not be brought above 1.150). The result, of course, was that the battery

quickly lost its charge. It would crank the engine a few three after charging, but soon was as bad as before.

"What caused the weak cell?" you may

This time the answer is easy. Lack of water and overcharging did it. During the early spring, neglect to add water to the cells caused the electrolyte to fall far below the plate tops and the front cell was particularly dry. This condition was aggravated by overcharging on long drives.



After a hattery has become fully charged with continued driving, any additional cur-The sen brough t nerely has a the make set 5 a limitation of gas and steam. The act on in tach I like he act we make a. off the plates, stripping the cell of its wherewithal to do husiness. If the rett a full of electrosyte, the full area of the plates. in a west and the effect of the overcharge g rattent is spread out to a more ryans degree. But if the coul is just half fulof electrolyte, only the lower halves of the places are in circult and the overcharging effect in doubled.

Add Water to Battery Weekly

The remedy for such a condition is to add water at least once a week during the summer. If no water is needed one week, examine the battery the following week just

the same. The second point for you to remember is to run with the headaghts on whenever the battery is charged. The state of charge can be roughly determined by the nitch of the horn.

There are many recognized methods of examining a car preparatory to general spring repair work, but I have found the 14 points libustrated on the previous page to be the most effective.

Tighten All Nuts

Whather or not these tests show any faults in your car, there are a few small jobs that should never be neglected. The outstanding of these is to give the car a general tightening up. No put, pin, screw, buit, or stud of any importance should be overlooked. Let me recount a few of my experiences

Last summer I was following another car along a country road when I saw the front end of its propeller shaft drop. Before the car could be stopped, the shaft caught on a large outcropping of stone that bent the shaft and gave the axle a wrench that broke a spring. Examination proved that this was clearly a case of neglect to tighten nuts.

they are duty, using on gon. 3. Death oil from transmission by removand plug. Bush with kerosene, and fill one third full with beavy oil

Wash clutch surfaces with kermene if

4 -- Fill universals with soft greate

with new oil.

5. Drain oil from reas axle, flush with kerosene and fill one quarter ful, with heavy out

Remove bub cape and fill with medium

7 -Fill steering gear bousing with medium

#-- Lubricate springs if dealed

■—Fill gream cups and oil holes

10-Tighten all puts on car. Do this systematically so that none is overlooked. 11 — Add water to storage battery.

12-Drain radiator and refil-

13-Clean sediment from carbuletor strainer and small strainer in vectors. tank intake

14. Remove strainer from engine lubricat. ing system and clean with become

Another driver stripped the starter teeth on the flywheel because the nuts holding the starter had loosened up enough to permit the starter to slip somewhat out of mesh so that the flywheel teeth and the pinion teeth just meshed at the tip.

A friend of mine, owner of a large sixcylinder car, had the unpleasant experience of rear axis and wheels parting company

with the rest of the car while running between \$5 and 40 miles an hour. I might go on almost indefinitely recounting instances of trouble and damage caused by failure to tighten parte.

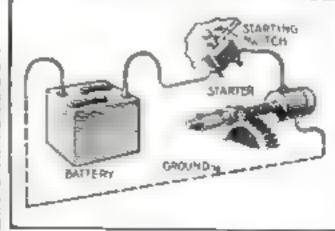
Just remember that when an automobile is running, every little part on it is vibrating. In time vibration will locust any nut unless secured by a good locknut, and it will wear

away most cotter ping. That's why it is so necessary to tighten every nut, pin, bolt, and screw that you can reach. Electric connections especially should be gone over frequently. If they are kept tight and electric wires kept from chaffing, you will have very little electric trouble. Remember that a wire that chafes against anything is a potential short circuit.

Know Your Car

Your BAFFAR

THE starter circuit in as storote as a house bell circuit. The current supplied by the storage battery through heavy cable, the circuit being elowed by the starter



switch. Instead of a return wire from starter to buttery, the return current flows through the car frame, one terminal of both buttery and starter being grounded.

On most cars the pinion on the starter motor meshes with teeth cut in the flywheel, while the starter shaft on which the pinion is mounted is spirally cut. When the starter pedal is depressed, the starter motor begins to spin and thus acrews the puriou gear (which is automatically prevented from rotating) out to the end of the shaft and into mesh with teeth on the flywheel. As soon as engine starts, the flywheel runs faster, sevewing the pinion back out of mesh.

Ordinary starting troubles are weak battery, short cir-cuit in cable or starter switch, dirty switch, loose connections, brushes worn, or commutator dirty. Dirt or gummed. cil on the starter shaft may prevent the pinion from meshing.

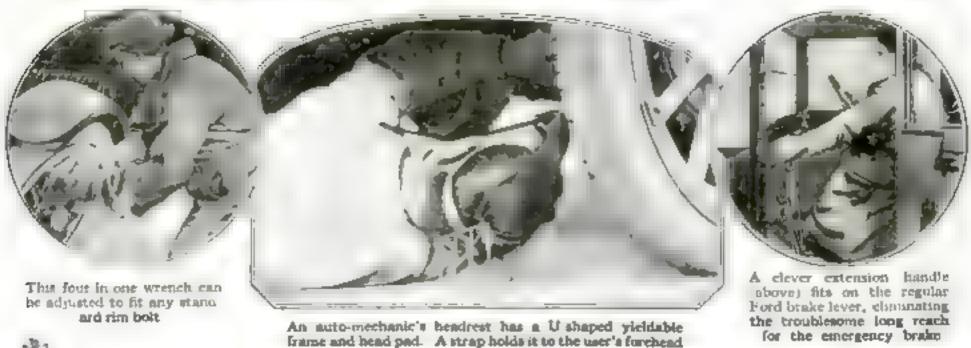
Remember the Radiator

One of the left-overs from winter in the nati-freezing inquid in the radiator. Not only should you drain the compound from the radiator, but you should flush the system with a solution of weahing sods and water, using a pound to a guiion, and run the cur for two or three days before draining it off and filling with clean water.

Some gasoline also should be drained from the carburetor to remove any dirt lodged in It. The little wire filter screen at the point where the gasoline enters the vacuum tube should be removed and cleaned. And rectainly the carburetor abould be adjusted for warm weather.

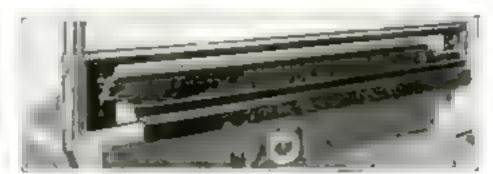
To insure proper lubrication, drain the old oil from the engine and replace with new oil,

New Accessories that Add Pleasure to Motoring





The two gaskets required in the ordinary spark plug are eliminated in a twopiece plug, shown at left, the porcelan insulator and upper part of shell being in one

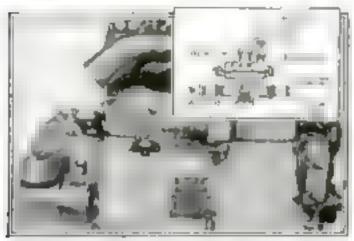


The "low gasoline" alarm shown at right is designed to screw into the filter opening of the tank. It contains a bell that rings when the gasoline supply is low



5

A new ventilator for Forda above, at right) does away with direct draft on face and head, protects coulon, and can be locked in any position



A new safeguard against engine damage is a disphragm that shuts off the gasoline sopply when the oil supply fails



An unusual eye shield of clear celluloid lat left has V-shaped cut to fit the nose. A flat spring device ships on the cap holding the shield in position



This new luggage carrier folds ingeniously at the outer edge of the runningbourd, where it is bolted, mapping open for use

but do not flush the engine with kerosene. This is the logical time to remove the oil filter screen and clean it.

Transmissions usually give little trouble, but every one of them should be drained of the old oil, flushed with herosene, and receive a supply of new oil. The same applies to the rear axis. The universal should be filled full of a medium grease—a process that should be repeated every 2000 or 3000 miles. Wheel bearings and steering gramage should be filled with a medium grease. Every grease oup and every oil cup should be given its full quota of lubricant.

Clean All Ignition Parts

Ignition parts should be cleaned and adjusted. This means particularly that the breaker points should be examined, filed, and adjusted if required. The distributor should be wiped clean and the spark plugs should be removed and cleaned unless it is your practice to do this work whenever valves are ground.

If your car has been laid up, it may be that the putons have rested to the cylinder walls and the engine cannot be turned over I sually the pistons may be loosened by flooding with kerosene and allowing to stand. But in some cases it is necessary to dismantle the engine in order to free the nistons.

You may have been unfortunate enough to have had your radiator freeze during the winter. If the radiator leaks badly, it may be cheaper to throw it away than to attempt to repair it, aithough a radiator compound as frequently effective. If the tubes are cracked, the remedy depends on conditions.

Almost any motorist is competent to do the simpler jobs I have outlined. But I do not advise an inexperienced man to adjust engine bearings and rear axle bearings. Valve grinding is a job that almost any man used to handling tools can do, but my experience is that the amateur's job is not always successful

There is one final point I want to emphasize. Not long ago a car was brought

to me which backfired so badly that it would hardly run. Muffler explosions were occurring regularly. The owner said that he had just spent an entire Sunday grinding the valves. I found the valve adjustment perfect but the valve stems proved to be a trifle loose in their guides. I told him that the trouble could be nothing but shoulders on the valve faces—shoulders that he had created by grinding. To cure the trouble, the cylinder head had to be removed, the valves refaced, and the seats trued up. The shoulders on the valves were very slight, but they were enough to produce a very hadly running engine.

Shoulders Should Be Removed

The point here is that the motorist who otherwise does a perfect valve granding job rans the risk of failure unless he removes the shoulders on the valve faces, and he needs experience to judge this point. Removing shoulders in a slow process unless special equipment is available.

Auto Generator Is Easy to Install

By George A. Luers

ELEC-A TRIC generator for recharging a storage battery on automobues not so equipped, esn be easily installed by the car owner at amail cost and without any radical alterations to his engine. The ndvantages of such an installation are obvious. It permits the use of electric light and provides a separate source of current for the ignition as well as current for an electric horn. cigar lighter, and any other attach-

ments that may appeal to the owner. One car owner who added a generator was sufficiently experienced in electric work to rewind the motor of a small fan so that it would serve as a generator. If It is not desired to do this, a small generator can be obtained second hand at a moderate cost from a dealer in wrecked and dismentied cars.

DETAIL OF SALEY METAL PLAN AULORETS D-D TO PIT BODY OF DO READ HERE GATOR 80.76 CAMP STRING MI AB WHEN TO BUTTLOW CYLINDER WEAD BELT DRIVING FAM AND GENERATOR, FAM ADJUSTMENT HERR BELT THANK

A SHALL SENERATOR OR A CONVERTED FAR HIGHOR IS FITTED WITH A AMALL PLANSED FAN PULLEY

The fact that one helt drives both fan and generater makes this a simple installation

The generator is attached to the car, as shown. by a strap that encircles the generator and is held by the cylinder head bolts. The strap is of heavy gage sheet iron and need not be particularly rusgod, as the belt drive does not place much strain

A pulley as fixed to the shaft of the generator so as to come directly in line with the fan polley The drive as obtained by increasing the length of the fan

on it.

belt and running it jointly over the fan and generator pulleys. The fan pulley adjustment is used to obtain the best berupper nounned

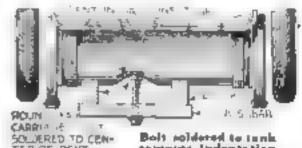
This method of attachment and driving will apply to practically any engine.

If the generator is in good condition and the belt adjustment correct, the device will prove practically foolproof.

Bolt and Wooden Blocks Repair Dented Gas Tank

IF EVER the gractime tank of your car becomes dented, the tank may be repaired simply in this manner:

The first step in to fill the tank with water and drain it, to avoid any possibility of a gusoline explosion when solder is applied. A round end carriage bolt is then



TER OF DENT compres Indentation

soldered firmly to the center of the dinged portion of the tank. A crembar with two blocks is fitted over the dent so that the threaded and of the bolt passes through it. By means of a nut and washer on the bolt sufficient pressure can be exerted on the depression to draw it out flush.

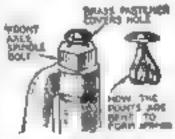
If a hole was made by the collision, the same method may be used and the opening filled with the solder left after the bolt in

removed. M T.

IN WASHING YOUR CAR, guard against using too much soop, gasoline, or any cleanaer intended to cut grease. If allowed to remain too long on the finished surfaces, they are apt to damage the varnish -R K.

Brass Paper Fasteners Will Replace Lost Oil Tapa

OIL taps or oil hole covers in wood the chamis of an automobile bave a tendency to work out and become lost on the road. As a temporary substitute that will provent grit and dirt working into the



Emergency covers for open all heles

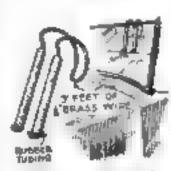
bearings, paper fasteners can be used by doubling the ends in and forcing them into the screw holes. This covers the opening tairly well and is easily removable. This method serves for either drilled or threaded holes,- P. B.

This Detachable Windshield Cleaner Is Quickly Made

FTER barely avoiding a head-on colluron because of a wet windshield, I was presented with the windshield cleaner illustrated, by a mechanic who made it on the appt. He used two 10-is. lengths of rubber tubing placed over the anda of a 8-ft. length of stiff 16-in. brant wire, bent

as shown, so that the rubbers were about 4 in apart.

While not an enameled and polished article, the cleaner perves its purpose satisfactorily, is easily detachable, and can be replaced at very little expense when lost, -F. L. G.



er tubing desirate of

Building Your Own Gasoline Station

GASOLINE can be obtained at the By Fred T. Anderson

wholosale price only when a storage tank of 50 gale, expacity is available. With such a tank it is possible to buy directly from dealers at a cost usually about three cents a gallon less than the retail price.

When a tank of this bize, with the necessery fittings, is purchaused, the cost is so great, however. that it uses up the maving in cost that will be made later But a tank that will nerve every purpose can be constructed cheaply.

The one illustrated can be built for about \$10, including tank, pump, hose, and causing A 60- or \$5-gal oil drum,

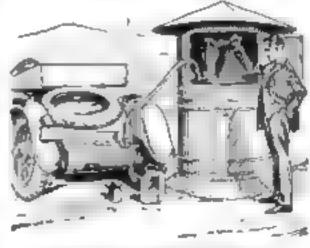
which can be bought second hand for from \$1 up, forms the tank. This is upended and a small retaining ridge of concrete put around it to hold it in place.

A cylindrical upper section with a contral cover is made from galvanized

Iron, riveted to the upper flange of the dram, which is provided with a hasp and padlock. A section of this upper casing is cut out and hinged to form a door. There is space in the hood for several gallons of hibridating oil.

> The pump is of the type used for inflating tires, and it is used to force the gasoline from the tank by increasing the air pressure within it. The hose connects with a pipe line set Into the tank with the lower and an Inch or two above the bottom, The filling cap is fitted with a gasket to prevent any leakage of air.

Several modifications of this method are peasible, one of the best of which is to bury the tank outside the garage and run papes for air and gas into a convenient corner of the garage. The problem can be adjusted to each individual requirement.



An aid of draw are m as a tan't for this home garage filling station.

Tacks Repair Broken Fan Belt

TACKS pulled from a roadside sign will often enable you to "rivet" the ends of a broken fan belt together. The adjustment probably will have to be loosened before the work is started. Then take a half dozen tacks, preferably once with large

beads, and force them through the two pieces of the helt with a pair of piiers. Place the heads on the inside and clinck over the points.

if the belt is so arranged that there is not sufficient alack to place it on a solld surface, the upper pulley may be used as an anvil.-K. L. R.



The Home Workshop

New and Useful Things to Make with Tools

How to Make a Vacuum Tube Set for \$20

By Joseph Calcaterra

Vacuum tube, which requires no storage battery, it is possible to make a regenerative receiving set for \$20 or less. That is but slightly more than the cost of a crystal set. This type of radio set, however, has a distance range of from three to five times that of a crystal set. Concerts up to a distance of about 100 miles can be heard

For those who already have crystal detector sets using a variocoupler as a tuning element, it is necessary merely to add a dry cell tube and socket, a grid condenser with leak, a rheostat, a 2214-volt B battery, and a 134-volt dry cell of the type used to ring house

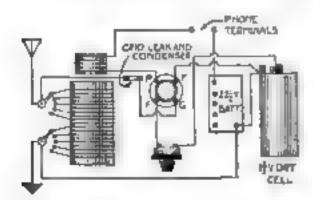
While this sounds like a long list of extra parts, all can be bought at practically any radio store for seven or eight dollars.

Those who do not have a crystal set will have to get a standard vario-coupler, a small panel about 3 by 6 in., two inductance switches, an instrument dist, 14 switch contact points, four binding posts or contact clips, 10 or 15 feet of annunciator wire, and a dozen \$4-in. No. 6 bruss wood screws or other acrews about that size. The total cost will not amount to more than \$4.50.

The other supplies necessary for a complete set are the serial equipment, consisting of from 100 to 150 ft. of serial wire, two serial insulators, a lead-in insulator, and a lightning arrester. This equipment should cost not more than \$1

Taxing the cost of each part of the set at the highest figure, about \$5 is left for the phones, which is sufficient to buy a very satisfactory bead set.

These figures are based on assembling a set from commercial parts. Any one who is handy with tools can make a variocoupler for about 50 cents. Brass acrews can be pressed into service as switch points, thereby saving another 40 or 50 cents. A condenser can be made at home and even a vacuum tube socket can be improvised. The total savings in this way would amount



This pictorial diagram of the hoak-up about be studied in connection with the photographs above

Has a Range of 100 Miles

EXPENSE no longer need deter you from installing a thoroughly offieight vacuum tube radio receiving set with which to hear broadcasting. The set shows below can be assembled to two or three evenings at a cost almost us low as a good crystal set.

Built and tested by our Radio Department at has been found to bring in stations within 100 miles with unlading clearness and fine volume of tone.



The top and front views of the set. The turning unit, or reclemapier, is at the left; the various tube grid condenser and grid leak in the center; the cheestat and butteries at the right

to \$2 or more, which could be applied to buying a better pair of phones or deducted from the total cost of the set.

If a new variocoupler is to be made or bought, it should have from 35 to 60 turns of wire on the primary and from 30 to 50 on the rutor

The set is of the single riccrit, regenerative type and the rotor of the variocoupler is used to provide regeneration. How this is accomplished is shown clearly by the wiring diagram and the photographe, which give the arrangement of the parts and connections between them. The antenna binding post or clip is mounted on the back of the panel near the upper left-hand corner. It can be seen in the top view of the set. The ground connection is made to the binding post or clip on the base shown in the upper left-hand corner, as seen in the top view. The phones are connected with the terminals shown just back of the variocoupler.

In the illustration the variocoupler is

shown mounted on a smaller block of wood, which in turn is placed on the main base. This was done because the coupler tube in this case was not long enough to raise the rotor shaft to the desired height. Whether you will use this arrangement depends on the type of coupler you buy or make.

In connecting the taps of the variocoupler with the switch points, start by connecting the tap which separates the single turn taps from the five or 10 turn taps, as the case may be, with the first tap of the "tens" switch, and then go outward from this point connecting such "tens" tap

with a switch point in order. Then follow the same procedure in connecting the units taps with their respective switch points.

Hook up the connections with the rotor first one way and then the other; that is to say, one lead should be connected with the plate of the tube and the other with the phone terminal and then the leads should be reversed. Leave them where they give best results

Any standard rheostat our be used and mounted by means of a small brees angle, as abown in the front view.

The set is very easily operated and is not critical in tuning, so that little difficulty to encountered in getting the various stations. It must be remembered that a dry cell tube must not be burned brilliantly; the rheostat should be turned up only until the filament of the tube shows a dull red color. Then the switch knobs should be turned to vary the number of turns in the circuit. This is done by setting the "tens" switch to a point and excying the units switch throughout its range, then shifting the "tens" switch another point and turning the units switch throughout its range, and so on until music or

aignala are beard

Usually results are obtained when from 30 to 40 turns are in the circuit. When signals or music are coming in as clearly as

Continued on page 104,

Parts To Be Bought and Their Approximate Cost

Vaccoun tabe \$1.00	Sinding poets (4)
Services 3	6.20
Carls condenser 25	Annunclatur
Rhepstat 50	wine S 6 .1D
Bloaterts 35	Wood agrees)
a see dry bat	dor 36 an.
tery 40	No. 6 . 10
Variatingalet 2 00	Arrial wire 150
1'and 1.00	1.00
Inductance	Aerial shoulators
swit her C 40	10
lostrument dia 10	Lead-in Insulator 10
Coplect Soubts	hgliening.
474 20	Arzener 1.25

The total cost for these is \$15.30, to which must be added the price of phones, which ranges from \$4 upward.

Grandfather's Clock Cases You Can Build at

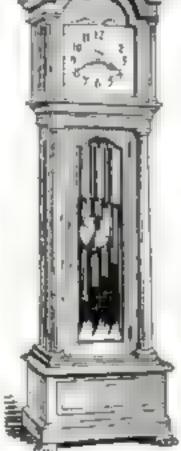
TOW many times have you heard the silvery chimes of a grandfather's clock sound melodiously in some fine old home and wished you had such a clock

of your own?

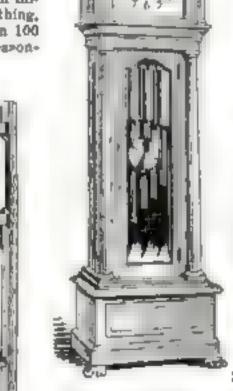
To buy a commercial grandfather's clock is expensive, especially if the case is at all elaborate and the works of a good quality, but the home mechanic who is reasonably skilful with bis tools and enjoys doing cabinetwork, can make the case at a relatively small cost for materials, and can buy, for prices ranging from \$5 to \$250 or more, clock movements and date all ready to be in-

stalled.

Once made, the clocic represents a value far in excess of the gnaterial that went into it. It is m permanent inventment, like a fine painting. It will im-prove, if anything, with age, and in 100 years, with reason-



Recentifing come of the finant modern floor slocks in its simplice-ity and quiet becauty, the case the lustented above is ideal for the amateur craftsman, because the amatour cratterian, because the construction is straightforward and not too difficult. Full size details and a complete bill of marketals are variained in Bluepriet No. 19 of the Horse Workshop series. No. 1, at the left, is a se-culted "Mission" chack, and Nos. 2, 3, and 4 are other becommon grandfather's clocks



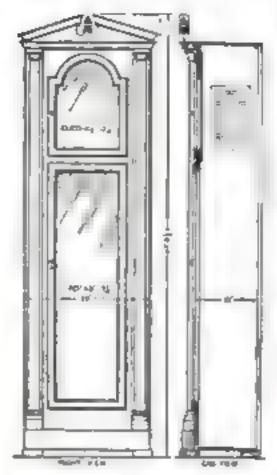
able care, will look as well, keep time as correctly, and chame as sweetly as when new. Many old-fashioned Colonial clocks are in perfect running order today and are worth much more than when the old-time cabinetmakers built them.

Designed especially for readers of the Home Workshop and simplified as far as consistent with good workmanship, the clock case shown at the top of the page, in the center, is one that is well worth the making. In its simple lines and fine proportions it resembles the best of the modern cases, and yet the construction is straightforward and simple

In view of the amount of time required in making the clock and the comparatively small amount of stock required, a selected hard wood should be used, preferably mahogany, walnut, or quartered oak.

How the Case Is Constructed

The clock is 7 ft. 614 in, high over all, 2 ft. 5 in. wide, and 17 in. deep. The case is really a box, 7 ft. 1 in by 2 ft. 2 in by 13 % in., the front of which is a frame made of two stiles 34 by 454 in. by 7 ft. I in .. and three rails. The upper rail is cut to conform to the curve of the top of the door, the center one is 1/4 by 2 by 16 in., and the lower, 1/4 by 8 by 16 in. Upon this are planted two pilaster stiles 14 by 314 in. by 7 ft., and on these in turn are mounted tapered pilesters 1/4 by 21/4 in. at the base. These have an prosmental base composed of a molding and the base block, which rests upon the main base, 21/2 by 4 in. by 2 ft. 214 in. At the top the plienters are



Coursely the Metenpolitan. Moreon of Art

An unusually disborate Colomial grandfather's slock

capped with another molding and a small flat cap that supports the top frieze filing. Against this is fixed a molding that runs around the top of the case

The top urnament, which is sawed from a piece 14 in. by 6 in. by 2 ft. 5 in., is trimmed with a molding broken out at the center and returned upon itself. In the center is a keystone with a turned and carved flame ornament or a plain turning, as preferred.

There are two doors, the upper one with an arched top that fits against the top face rail. The radius of the outside of the upper

> Tail of the top door is 7 🌠 la. Hack of the top door, fastened to the top and center face rada, la a mat cut out of a piece 38 by 18 by 28 in. to



frame the dial of the clock. The ends can be solid or cut out, as shown by the dotted lines, for small fretsaw doors backed with silk, These act like the doors of a phonograph sound chamber and allow the sound of the chimes to escape in

greater volume. The openings can be as small as 4 by 5 in., almply backed with silk, if desired, to avoid the work of making the doors.

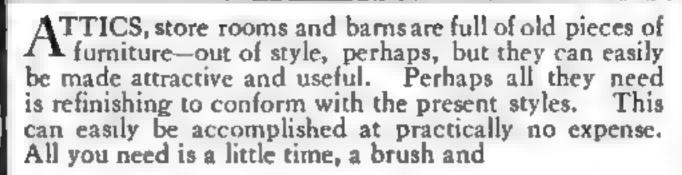
The back is poplar, whitewood, plus at other soft wood, lipped on the edges with wood to match the rest of the case. It projects 3/ in beyond the ends. as indicated by the double line on the front view. In other words, while the case itself is 2 ft. 2 in. wide, the back is 2 ft. 2 ¼ in. wide



The base block is also 2 ft. 214 in, long and, to avoid showing the end grain, it is mitered at the ends, and filled in with two small mitered pieces that show the edge grain. The feet are simply blocks 14 by 4 by 4 in., with the corners rounded. The top of the case in 1/4 by 13 1/4 by 2 ft. 1 1/4 in and the bottom 16 by 1214 by 24 4 in.

Full size details showing the more important points in the construction of the case, as well as a sectional plan view, two full size alternate designs for the ornamental turnings, and a full size templet of half the upper door frame are contained in Blueprint No. 19 in the Home Workshop series. This also contains a complete bill of materials with dimensions and notes. It will be sent to any reader for 25 cents to cover the (Continued on page 111)

How You Can Change Odd Pieces Into Masterpieces



JOHNSON'S WOOD DYE

Johnson's Wood Dye is very easy to apply—it goes on easily and quickly, without a lap or a streak. It penetrates deeply, bringing out the beauty of the grain without raising it—dries in 4 hours and does not rub off or smudge.

Johnson's Wood Dye is made in fourteen beautiful shades, all of which may be easily lightened or darkened—full directions on every label.

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This book tells how to finish wood in artistic stained and enameled effects. Gives practical suggestions on making your home attractive, cheery and inviting. Tells just what materials to use and how to apply them. Use Coupon Below.



This book is the work of experts—profusely illustrated — contains color charts—gives covering capacities, etc. We will gladly send it free and postpaid for the name of your dealer. Fill out and mail coupon at right.

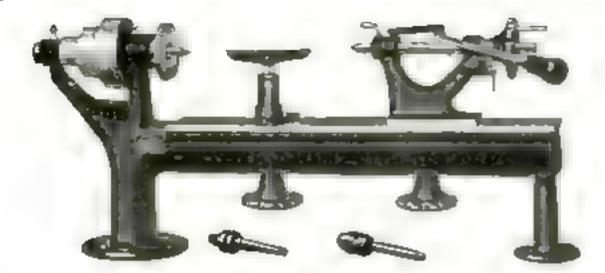
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His Address

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Bench Lathe No. 125 Price, \$36.00

Length over all, 25 inches. Height 11-1/2 inches. Swing, 7 inches.

Do all the work at home

You start to work out a mechanical idea at home. You can do all the work up to a certain point. Then you must let some one else complete it. Because you do not have a bench lathe, you lose all the satisfaction and pleasure of finishing the experiment yourself.

A Goodell-Pratt Bench Lathe will enable you to complete your work without machine shop delays and charges. You work out the idea for the cost of material alone.

One model, that shown on this page, answers every need of the home worker and experimenter. It is moderate in price, and accurate, and will give you long service.

Another size has a larger Tee Rest and are used to a longer Bed. Otherwise both are alike. In the vise. Every properties that cannot be done on the face and degrees, and these Goodell-Pratt machines by using and wad special attachments.

Every lathe is provided with an adjustable Tee Rest, a Slotted Face Plate, a Saw Arbor and a Drill Chuck with a No. 1 Morse Taper Shank. The Chuck holds round shanks of all sizes from 0 to 1/4 inch.

Write us for our free illustrated booklet, "Bench Lathes," and catalog No. 14, showing all the Goodell-Pratt 1500 Good Tools.

GOODELL-PRATT COMPANY, Greenfield, Mass., U. S. A.

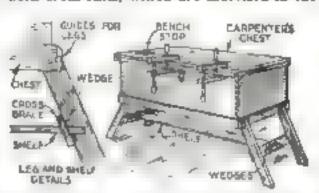




THE HOME WORKSHOP

Lega Convert Carpenter's Chest into Portable Workbench

A CARPENTER who has a great deal of elaborate cabinet repair work to do away from his shop, uses an ordinary carpenter's toolchest as a bench by supporting it on legs, as abown. The legs are notched to take the chest and are prevented from slipping by guide strips acrowed to the ends of the box. The legs are connected in pairs with cross rails, which are mortised in the



Fitted with strongly braced legs, this large toolchest surves up a woodworking bonch

center to take long tenons at each end of the central shelf or brace. These tenons are held by wedges.

On the top of the box is a simple worlder bench stop for use in planing of the risk bench are clamped with hand a take a the projecting rim of the lid, thus doing away with the necessity for a vice.

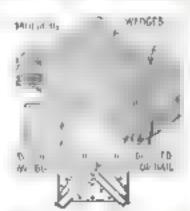
For the home carpenter who has no room for a large bench, an arrangement I to the car be used advantageously a class of some up it a more room than the translation and can readily be moved from place. F S E.

Simple Wooden Vise Aids in Joining Picture Frames

THREE blocks screwed to a base block or the bench, as shown, form a substantial and quickly made picture frame vise for the home workshop. Two wedges are used to clamp moldings of various sizes in the vise.

Every precaution must be taken to have the face angles of the maids block just 90 degrees, and all bearing surfaces of blocks

and wedges should be planed at right angles to their sides. As otherwise the wedges will not bold well and the moldings may not be flat. All the parts should be made of a hard wood such as maple of oak, and plenty of acrewa used.



Wedges held the molding In place for nailing

In placing the molding in the vise, a slight allowance should be made for the tendency of the wedge to carry the molding along with it as it is driven home. Then, when the pieces are clamped, a hole should be drilled through each piece and started into the other piece, the holes being slightly smaler than the brade or nails that are to be used

Any one who has struggled to nall a mitered frame in an ordinary vise will appreciate this simple fixture. ROBERT N STANKARD, Eltingville, N Y



Immediate Demand for New

Cumigham

Amplifier Tube

Type C-301-A

List Price \$9.00

The most efficient vacuum tube ever placed on the market for amateur and experimental use. The engineers of the General Electric research laboratories have at last succeeded in perfecting a tube that every owner of a radio set has been waiting for.

Greater Power Amplification Only 4 Amp. Filament Current

HIS new and improved Cunningham C-301-A Amplifier is a high vacuum tube designed for use as an amplifier and detector, containing a new Tungsten Filament, the characteristics of which are long life, low power consumption, low operating temperature and greater power amplification than any previous amplifier tube. The tube has a standard four prong base, and the glass bulb has the same dimensions as the C-300 and the C-301.

The greatly reduced filament current permits the use of four of these tubes without exhausting the A battery any faster than when using one of the previous type of amplifier tubes.

Complete instructions for the care and efficient operation of this new Amplifier Tube are packed with every tube.

Insert a C-301-A in your amplifier set today. Note the improved quality and increased audibility.

The Countrylean Turketed Sures is at your Service. Address your problems to Dept. P.

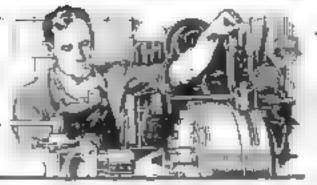
2. J. Quiningham

248 First Street
San Francisco, California

154 W. Lake Street Chicago, Illinois

Better Shop Methods

How Expert Mechanics Save Time and Labor



Simple Shopmade Filing Machine Saves Hand Work

FOR the average shop, this stordy yet simply made filing machine is a real time saver. It reduces the amount of ted,our bench work and performs thoroughly and efficiently a thousand and one laborious filing jobs.

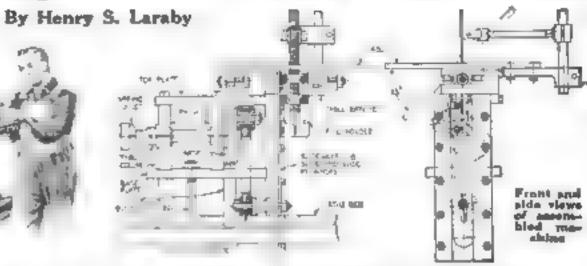
The machine can either be used as a lathe attachment, or it can be mounted on the bench or on a pipe floor stand, and driven by a small motor or other source of power.

Requiring no castings or parts difficult to machine, it is, nevertheless, of sturdy, substantial conattraction and will stand up under ordinary shop usage for years. Ad-

justments are provided for compensating for wear at all vital points, so that the small machine runs smoothly at all times.

The construction of the parts is shown in such detail in the accompanying illustrations that little explanation is required. When used as a lathe attachment, the bed plate is belted to the lathe bed and the

yet By Henry
real
ment
thorone



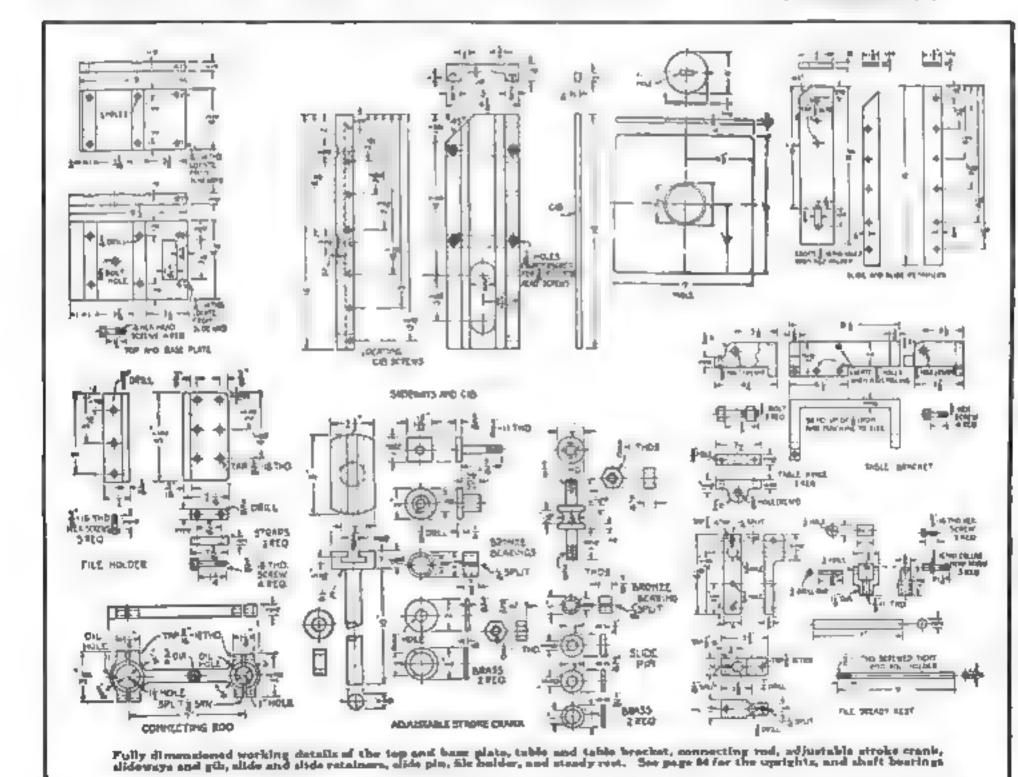
shaft is driven by means of a spring collet. A crank and connecting rod convert the rotary motion of the spindle to a reciprocating motion, and the file, held in a file holder, slides up and down. The crank is designed to give an adjustable stroke with a maximum range of 3 in.

The fact that the entire machine is made

of machine steel with the exception of a very few parts, adapts it for construction in the average small shop where there might be more or less objection to having special castings made.

While the hearings may seem somewhat elaborate, since they are split instead of

(Continued on page \$1)



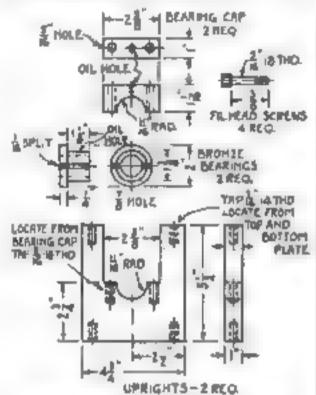
BETTER SHOP METHODS

Simple Shopmade Filing Machine

(Continued from page 80)

solid, they will be the best in the end, as any wear can be taken up, and the machine will run for years without new bearings. The ordinary round bearings get oval after a tirus and this will cause a clank and jerk on a machine like this, so that it would run smoothly only for a relatively short time

Note particularly that the sade is 9, 16 in thick, while the slideways are only 14 in deep, so that the sade retainers must be



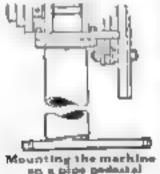
Have the main uprights and bearing cope are made, and details of the hearings

shimmed up 1/18 in. This allows for adjusting the slide retainers to take up the wear in slide and slideways.

The machine was designed after one I naw in a jobbing shop, but several improvements have been incorporated. The original machine, which has a frame of east ron, also has a 3-in, stroke, but is limited in the range of the angles at which the table can be talted. While the excessive angle of 45 degrees possible with the table of this machine is not necessary for die work, which seldom exceeds a 3-degree

angle, a tilting table
of this range is
handy for many jobs
that come in the line
of flung
On the original

On the original machine, when a short atroke a used, the die holder does not come up close under the table on the up stroke and is quite a distance



away on the bottom stroke. This given quite a spring to the file, and I have remoded the difficulty by putting an admittable slot in the slide itself, so that, when using short strokes, the slide can be adjusted to go up close under the table. I have also made the slide narrower, so that the extreme width of the part that goes down through the lathe bed is 4% in This will allow its use on the average lathe.

Kerosene Used in Scraping

THE formation of deep scratches in scraping cold rolled stock or tool steel, will be greatly lessened if kerosene is applied to the surface.—B. H. U.

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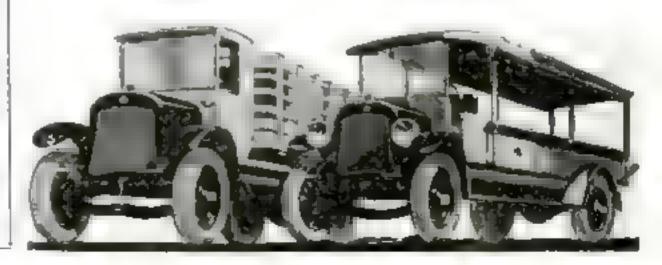
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He always says "Davenport I-o-w-a where the West begins."

Instantly recogn sed. Distinct, clear as a bell the voices and music, within the radius of your sutfit, come to you if your radio is equipped with the

Stromberg-Carlson Radio Headset

Quick'y adjustable to any size head, very confortable at I so reasone, faint long distance signals are reproduced accurate y

Its forked cord construction makes it do double duty when necessary. The receivers can be separated and used by two observers at the same time.

Backed by 6 years' experience in the manufacture of radio apparatus and 28 years' experience in the manufacture of high grade telephone equipment.

That's why it's the Headset for you

Order Stromberg - Carleon apparatus through your electrical merchandise dealer or write for free bulletin describing exclusive Stromberg-Carlson features.

STROMBERG-CARLSON TELEPHONE MFG. CO. ROCHESTER, N. Y.

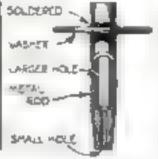


BETTER SHOP METHODS

Detachable Cleaning Nozzle Fits in Air Compressor Coupling

IT IS desirable to have a nozzle with a small jet for use on the acorn type of coupling for the air tank or compressor. This serves many purposes, such as for





Pressing the needs into the coupling makes a powerful air stream available for cleaning

blowing out p per and removing particles of carbon from cylinders.

A serviceable jet that can be applied quickly is the one illustrated. It consists of a cylindrical bar drilled with two holes, a large hole at one end and a small hole at the opposite end. Over the bar a washer is soldered or brazed to form a finger hold when the nozzle is inserted in the coupling. The pressure of the fingers keeps the valve open.

This fixture is easily made and is a time saver whenever a jet of air is required for cleaning purposes. E. L. Y

Funnel Guard for Drill Chips

WHEN drilling overhead holes in metal with a hand drill, a guard to estch the chips may be made by placing a small funnel over the drill point. This expedient in med regularly by a Washington, D. C., mechanic in drilling holes in car frames from beneath. He

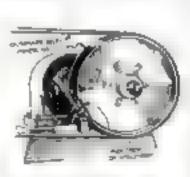


adopted it after a falling chip had nearly cost him the night of one eye.

In boring overbead holes with a brace and bit, a similar guard may be used to advantage.—M. C. F.

Removing Oil from Drive Belts

OF MANY methods suggested for removing on from oil-soaked drive belts, such as washing with gasoline and applying chalk, one of the best in to shape a piece of



sheet Iron of fairly but vy weight, as shown, and mount it on a temporary holder so as to hold it is a diagonal position against the face of the engine flywheel. The iron will soon be

ground to a knife edge. The oil on the face of the flywheel will then be skimmed off and in a short time nearly all the oil in the best will have been extracted ROBERT SCHRORDER.



Difficult DrillingJobs Made Easy

THE "Red Devil" Automatic Chain Drill makes simple work of the most difficult drilling jobs, and makes good results a certainty. For drilling iron or steel, truck frame, engine cylinder, angle irons, etc.

With it you can do many repair jobs yourself that you would otherwise pay to have done.



It's Automatic!

No heavy bearing down is necessary. The automatic feed does it all. You turn the brace- the bit pulls itself through metal as an auger bit through wood.

The "Red Devil" Chain Orill No. 20.8 costs, but \$4.80, and pays for itself in a short time. On sale at responsible dealers, or direct from our factory

The "Red Decil" Mechanic's tool landlet shows the tools best suited for your particuter purpose—it's free for the eating.

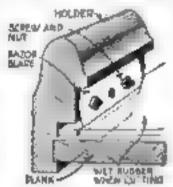
SMITE & HEMENWAY CO., Inc.
Manufacturers of "Raid Dunt" Tools
264 Brondway New York, N. Y.

"Red Deville Glass Dutters—the singlers' standard took of the storid, "It's all its the wheel" Made to the Styles. No. 124 phones below. 3th

BETTER SHOP METHODS

Cutting Belt Laces and Rubber with Razor Blade

FOR cutting strips of leather to make belt laces, or for preparing narrow strips of rubber such as are used against glass in the windshields and windows of automobiles, the tool illustrated will save much time. It is simply a wooden holder, shaped



The blade builder arrons

an shown, to which is sttached a safety taxor blade

The leather or rubber to be cut in placed on the edge of a plank and the tool in drawn along the edge, something like a marlong gage. It is easier to cut the rubber

smooth and atraight if it is first wet with water

If the guiding rabbet of the holder does not alide as smoothly as desired, rub the edge with soup. The razor bade can be replaced when dull.—L. D. P.

Saving the Air Tools

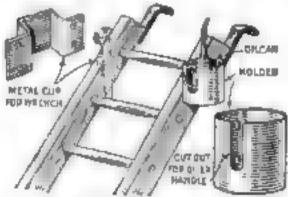
FROM personal experience as a repairmen on air-driven tools, such as drills and riveters, a friend has found that advice regarding their care is badly needed.

The working parts of such tools, especially the valves, are fitted to close limits and should be carefully protected from dirt. As most of my friend's repair work is caused by scale and dirt from the sir pipe line, he prevents some of the trouble by placing short pieces of pipe in the sir line. These collect any scale or dirt that might be rolling along the bottom. He also continues the end of the line a little beyond the last branch of the air line to form another pocket for dirt and scale.

When piping new lines, he takes all the branch lines of the main line at the top and puts in a dead and dirt pocket for each one, because while many air tools have strainers in them when new, the strainers often are lost.—F. H. Swarr.

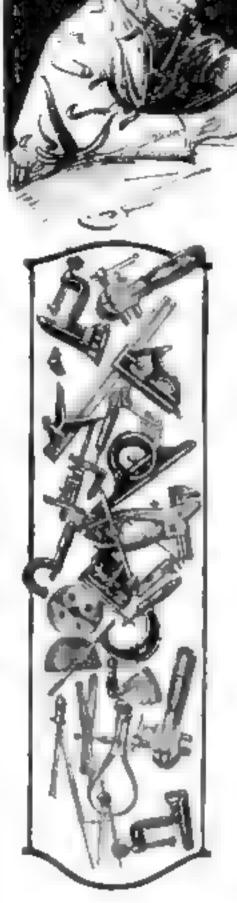
Line Shaft Oiling Made Easier

THE line shaft oiler will find his work simplified if he equips his ladder, as shown, with a holder for the oilean and a clip for the wrench used in tightening



Wrench and officen hept handy in believe

bearing-hox holts. The container for the oilcan is simply a heavy tin can of suitable size. It should be deep enough so that there will be no danger of the oilcan falling out when the adder is shifted.—E. N.



A

Writis your letter on this subject,

"How Starrett Tools Have Helped Me Most in My Work"

Cover these publicar

I Superior features of Stanfell Touls.

2 Adequates of any part cular Stanfelt Toul.

3. Number of practice about I have found for the tool chusen place.

Note: Content place a be exhibite must have seed Stanfelt Tools prior to Feb. 19th 1923.

Blad to Canton Eslear 'The 1, 5, Secrets Co. Inc. Albert, Mars. and leave then April 15, 1923

Starrett Tools FREE

Any machinist, carpenter or mechanic in the United States or Canada can enter the Starrett Prize Contest. If you use Starrett Tools, you know why you prefer them. Put down your reasons in plain language and send them in.

474 separate prizes of Starrett Tools (sets and individual tools of your own selection) will be given for the best letters. (See "A" above for points to cover.) All Starrett tool users have an equal chance. Literary skill doesn't count in this contest. Facts will win the prizes.

You can get all the details at any store selling Starrett tools. Ask for the free Prize Contest Booklet containing free instructions, description of prizes, etc.

(Write for copy if dealer can't supply you.) Mail your contest letter promptly. You may win the Grand Prize—\$150 worth of Starrett Tools (list prices) of your own choosing. And there are 473 other prizes. Enter today. Contest closes April 15, 1923.

Write for Starrett Catalog No. 22 "W" and the Supplement describing the new Starrett Tools.

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ATHOL, MASS.





Starrett Prize Contest

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Irwin bits are made with carefully designed cutting

heads to meet each boring requirement.

And in every IRWIN Bit you will find perfect co-ordination between the essential parts—the Screw, the Spur, the Cutter, and the Threat.

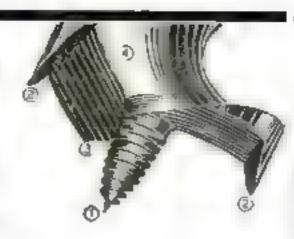
The Screw-No. 1

The pitch of the screw determines the speed. at which the bit will bore. Hence, the kind of boring done should determine the pitch of screw used.

The Cutter-No. 3

This cuts under the chip after It has been second by the spur, and starts the chip apwards to the throat of the bit. That's

why cutters must be well tempered, keenly sharp, and evenly balanced, otherwise the bit will "drag."



The Spur-No. 2

The length of the spur must conform to the pitch (or speed) of the screw to make the cutting smooth and easy.

The Threat-No. 4

Free passage must be given the chips to permit an easy flow up through the "twat" of the bit That's why IRWIN Bits

have roomy throats; -- they can't "choke" and "clog."

If you want to bore easily cut, amouth holes in ALL kinds of wood, --holes that are 'cut true clear thru,' —ask your dealer for the IRWIN Het. Look for the IRWIN Trade Mark on the shank of the bit and the IRWIN Quarantee Tag. These are your protection and assurance of IRWIN Boring Service. Get our booklet, "How to Select, Use, and Care for Bits." It's free.

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Originators and Sole Manufacturers of the IRWIN Bit



BUILD UP YOUR KIT

for GREATER PRECISION

Let every tool you add to your lot fit you for better precision work. Add the finest tools you can buy -

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They give you the accuracy necessary for producing better work and more of it.

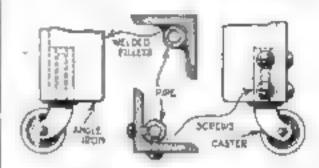
We are constantly studying the needs of the Mach met. Toolmaker and Garage Mechanic, and are frequently adding new tools and improvements to our ratessive line-it will pay you to keep our Small Tool Catalog on hand as a reference book and buying



BETTER SUCP METHODS

How to Fasten Casters to Angle-Iron Legs

DIAIN angle-fron legs, which are used frequently on office furniture such as filing cabinets, drawing tables, and racks, can be improved if provided with casters.



Short lengths of pipe form the excists for these casters

This can be done by using a piece of pipe to form the socket for the shank of the caster and fastening it in the angle by either of the methods illustrated. One is by welding and the other by drilling the angle fron for in round head screws and tapping the pipe to suit,-J. R.

Cheap Shop Floor Made of Earth and Iron Chips

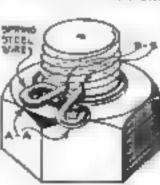
N THE outside shop, blacksmith shop. or even a garage used for trucks, a serviceable floor may be made at practically no cost if from or stool chips from the machine shop can be obtained. The earth floor is pounded down solidly, preferably with a layer of clay, or earth and clay, on the upper surface. Over this a mixture of steel chips and sait is placed to form a covering 14 in. or more in depth. Sprinkle water over this and tamp it down so.id. The man will soon rust and form a covering almost as hard as coment.

Unless the crust is broken, this floor will stand an unusual amount of usage without breaking up. This is a practice followed by some blacksmith shop owners, and if there ie a blacksmith shop near by, an inspection of the floor probably will show how the particles of from chips have made a substantial floor, whether sait has been added or not to hasten the renting.-G. M. E.

Spring Nut-Locking Ring Quickly Put in Place

BIMPLE nut-locking device, designed A and used by J. C. Huffer, a Denvez, Colo., mechanie, is made and fitted in place

Bend a length of spring steel wire into the form of a circle and loop the ends A A



Prevents the nut's

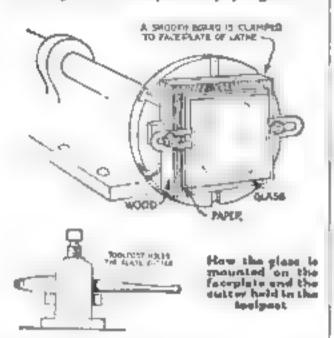
so that the points BB project within the inside diameter. Enlarge the circle by preming togother the loops and alip the locking ring over the end of the bolt until it is in place against the face of the nut. Then release the loops so that the points

will spring into contact with the bottom of the bult thread, exerting sufficient radial pressure to keep the device in place under shock or vibration.-LELAND F. JAMES.

BETTER SHOP METHODS

Glass Disks Quickly Cut with Glass-Cutter in Lathe

THE cutting of circular glass disks for gages, ammeters, headlights, and the like, can be done expeditiously with an ordinary hand glass cutter mounted in the tool post of a lathe. A flat board or block with a smooth surface is mounted on the faceplate and the glass is secured to the wood by means of a piece of paper glued on

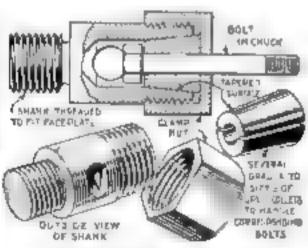


both sides. The glass cutter is set in the toolpost, rather close in to avoid overhang. Without waiting for the glue to dry, bring the tool nearly against the face of the glass and gage the size by turning the lathe and using a pencil to mark the position of the cutter. The cutter is then fed to bear about as heavily as in making a cut by hand. Several turns in the rathe mark the outline, and the glass is removed before the glass dries. The waste edges of the glass are

then removed in the usual way by tapping them lightly.—M. G.

Chucking Fixture for Bolts

A SPECIAL fixture for chucking benagonel head bolts in a lathe while channed the thread farther down the bolts and cutting them off short, was made as shown. By using a series of split collets with inside diameters to correspond to the bolts being



Parts of the shock and diagram, showing how it is used to hold belts

machined, one fixture will serve for several sizes.

A shank threaded to fit the lathe faceplate is drilled to accommodate the heads of the bolts, and a taper is turned in one end to correspond to the outside taper of the split collets. A clamp but is provided and a cross hule is drilled through the shank, so that a drift may be used to release the bolt and collet if they become jammed. -C. O



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Do you put off lugging it until it fails to give good resu is?

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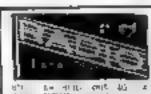
Tunger Buttery Charges over stee on Alternating Current. 2 ampare out ht - \$18 00. 5 ampure outlite \$28.00. aget of the Kackies Special attachment for charging 12 or 24 cent B Storage Barrery -21 00 -Ate either also Tungar-





\$25.00 in PRIZES

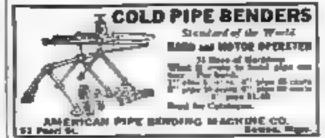




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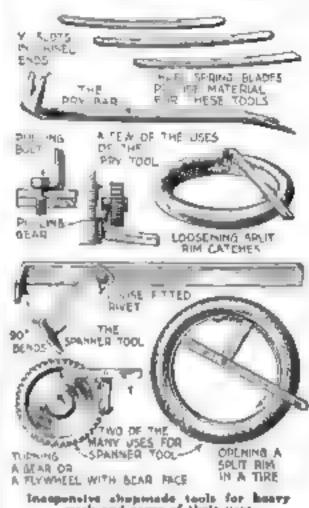


BETTER SHOP METHODS

Pry Bars and Spanner Tools Made from Spring Blades

THE pry bar and spanner tools illustrated were made to expedite the work in a busy auto repair ahop. Their cost was negligible insamuch se broken car springs provided the material

The pry bar was designed for general service, the 'V" openings being tased in pulling bolts, collars and small gears. The offset end was formed for getting into tight



Inauponates abspected tools for heavy

places. As a too, for working an tire rims and replacing casings, it has also given good service. The ends will book or unhook the majority of fasteners on split

The apanner tool has many uses. With it a flywheel may be grapped and turned, transmission and timing gears twisted on their shafts, and key slots and setscrew holes lined up. The double ends serve erther for pushing or pulling. For example, the tool is used to collapse a split tire rim by butting the straight end against the inside of the rim and hooking the opposite end over the other end of the rim

These tools are each about 2 ft. in length and the ends are quenched while bot to retain some of the tempering, so that they will not be too soft .- F. L. W.

Inking Small Circles

DRAFTSMEN who have occasion to draw many small circles, as in structural steel work for indicating rivet holes, or in map drawing, often have difficulty in preventing the small circles from fill-

ing up. This is because the pivot leg of the drop bow pen drope so far down that the thicker part of the point touches the pen. A paper aleeve, applied as ahown, will prevent this. - P. A. DASCHAE.



BETTER SHOP METHODS

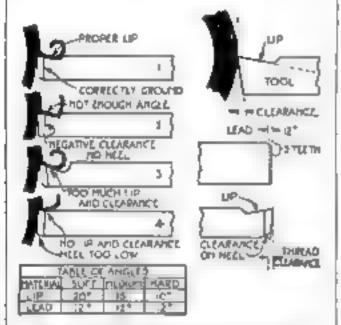
Secrets of Success in Grinding Thread Cutting Chasers

By John L. Chambers

Of ALL the toom used in the metal trades, few are more abused or less understood than the chasers used for cutting threads on pipes or bolts. Chasers become duli from use and missise and must be resharpened. Yet to recondition them properly requires care and experience.

The terms used to distinguish the chaser parts are "lip," 'make," "throat," or "lead," and "clearance." Referring to the illustration, it will be seen that a common lathe tool, set against a bar of stock, has been used to show the meaning of the terms and their application.

A lathe tool with a fiat top is said to have no rake or lip. When used to remove or



How the chasers chould and should mee be ground, and angles for the lip and lead

turn off metal, it pushes rather than cuts the chip, consumes much power in the operation, and leaves a rough and unfintahed surface. If the tool is ground with a receding plant, it will surl the chip and takes less power than the flat top tool. A tool so ground has lip or rake, and gives a very good finish to the work.

Too much lip or rake reduces the cross section of the tool immediately in the rear of the cutting edge; it cannot, therefore, darry away the heat fast enough and burns readily, and also is apt to gouge and dig in.

readily, and also is apt to gouge and dig in.
"Lead," "chamfer," or "throat" designate the part that first enters the stock or paper it is a tapered section on the first three full threads of the chasers.

'Clearance' is the backing away of the tool's lower surface, immed ately behind or below the cutting edge. Without clearance a lathe tool would rub and soon burn from the heat generated by the friction.

Like Other Lathe Tools

Since a pipe of thread chaser is only a multiple cutting tool, the same rules apply to it. When imperfect threads are cut on either har or pipe stock, a diagnosis should be made from the standpoint of the familiar lathe tool.

New pipe chasers often give trouble by not having enough lip and chip clearance ground on the front cutting faces. The proper lip angle depends much on the bardness of the material to be worked. The appended chart gives the proper angles for varying hardness as of stock or pipe.

(Continued on page 88)



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BETTER SHOP METHODS

Success in Grinding Chasers

Continued from page 87)

The end of the lip or rake should terminate in a generous radius to cause the chip to curl when striking the chaser. If ground with a sharp corner, the chips may break or become clogged, thus marring and spoiling the otherwise good threads.

The operator has no control over the clearance of the threaded portion of his chasers, and if it is not sufficient to cut good. threads, the chasers must be discarded. The clearance of the throat or lead of a se. of chasers must frequently be reground, as this constitutes the rough cutting part of the tool, and becomes dull from wear caused by the scale and grit embedded in the outer surface of the stock. This clearance should be a little greater than that on the threaded part, and must be ground alige on all members of a set. Great cure must be exercised in this, so as to secure even cutting and the same removal of stock by such individual chases

The angle of the lead will vary slightly with the kind of stock worked upon, a long lead will cut true and easily, while a short lead will start hard and cut hard

Grinding the Relief or Heel

A relief or beet is ground on the back edge of the chaser teeth, as shown, to prevent them from tearing off the threads. It should be deep enough to cover the whole depth of the teeth. The grinding should be done on a surface grinder, using a swivel hend vine. Where a surface grinds, a not available, the work can be done on the common type of brach grinder, but good judgment must be used to grind all of a set in the same manner

Referring to the Blustration on page 87, No. I is correctly ground in every re-Number 2 has too little hp, a negative elearance in the throat, and no heel at all. Thus set of chasers would tear off the threads. Number 3 has too much l.p. and while it would cut a good clean thread, it probably would cut a very wavy thread and would be apt to break because of the decreased cross section of the deeply ground lip. Number 4 has not enough heel and would strip off the top of the threads. It also has no lip, and would, on steel, only push off a chip, learing off the threads completely and requiring much power to operate. Since it has no clearance, it would rub and heat

In all threading, good lard oil should be used, or a suitable preparation for cooling and lubricating at the same time,

Leather Liner for Shop Anvil Lessens Sledge's Rebound

LEATHER liner between the shop anvil and the anvil block will lemen the rebound of the hammer, according to an old and experienced foundryman. The liner does not make the blows of the sledge any the less effective, but it does take off sumething of the sharpness of the upward

The most practical height for mounting an anvil is, according to the same authority so that the top of the anvil comes to the level of the workman's fist when he is standing beside the anvil with his hand hanging naturally beside him. With an anvil so mounted, there is a minimum waste of energy.-A. L.

You can come close to a 100% machine

Start with the thought that this stands for a certain production-figure. That figures are your only guides in getting there with the output.

Note the rate of production you start with, as registered by a Veeder Counter. Note the room for improvement -then watch it REGISTER, as better methods and mechanical refinements increase the output!

Every gain is recorded, every development O.K'd, when you're working toward a 100% machine with the help of a



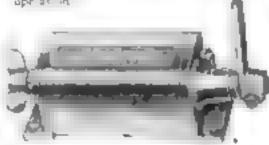
The small Revolution Counter below registers one for a revolution of a shaft, recording a practupe Though or product.



the methenism will stand a very high rate of speed, making it importally purtable for light, Inst-running mactures. and most at aptable to expenmental work It run bick-

ward the counter subtracts. Price 42 00. (Cut 4/5 size.) Small Rotary Ratchet Counter, to reguter recigrorating morements of proof machines, also \$2.00.

The Revolution Set-Back Counter below records the output of any marking where a shalt-myshit.on indicates an ope at in-



Sets tack to zero from any figure by turning knob on a round. Supplied with from four to ten figure-wheels. As remared. Price with four figure-wheels, as illustrated, \$10.00-subject to discount. Cut has then one-half size. Set-Back Rotary Rutchet Counter, to record remprovating into cinemia as no punch. presses, \$11 50 (Lst).

Whether you went to count production, packages or people, write for the new 30 page Vender booklet; the right sounter is there.

The Veeder Mfg. Co., 44 Sargeant St., Hartford, Com. BETTER SHIP MATRIDES

Simple Threading Method Saves Time on Difficult Jobs

By Jos V. Romig

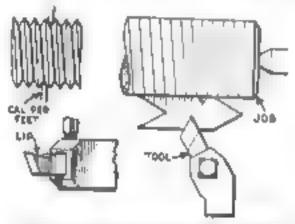
"THE rate on those piston rods and shefts stands just as it is, and not a cent more," said the night superintendent to the civinion foreman

'Well, I'll try out another new man on the job tonight," the foreman answered. "You see, all of the old hands threaten to quit if I put them on that muorable thread-

ing job."

And so he put a new man on the old 30-in, latte, which had been tooled up to turn out large compressor piston rods. Usually everything went well until the operators came to finish the thread on the cross head end of the shaft. This thread had to be a perfect fit with no play in a hardened gage, and had to spot up well on both sides.

The rate for both roughing and finishing operations was \$7 a rod, and one rod was the shop's record production for a good night's work, providing the operator had luck when finishing the threading. As all work had to be passed by the inspector



The type of tool used and the method of checking and testing the thread. Nate the broad fast of the saleper

before a piece rate slip was made out for the operator, there was no chance of pass-

ing off imperfect work

Out of the five men lined up at the timeclerk's office. Frank was selected for the 80-in, lathe, and was taken over and shown the lathe, the job, and the print. The foreman explained the details, and saked Frank whether he thought he could handle the job. Frank wanted to know the rate for the place, and when told, smiled to himself and saked where he could find the rough shafts. He plowed into his work and by midnight had the shaft ready for threading

During the lunch hour, a neighboring muchine hand made himself acquainted and told the new man the whole history of the muerable piston and red job told him how hard and close the inspectors held one, and how at least six men had quit the job cold, as they could not make any

money on it.

Frank was one of those who listen well and say little, but he thanked his infurmer. When the power started up, he ground a bit into a good, well-lipped roughing tool After taking a first light cut, be checked the thread line, to see that all was set and correct in the lead, and then tore out good chips until the thread was roughed out

Ignoring the offer of a spring tool holder from the hand across the since, he ground another tool, which he set in his left hand, solid tool helder, and proceeded to finish the thread. A finished shaft lay on treaties

Continued on page 90)



Why they stick

On the ground floor of the telephone building a man worked at the test board. It was night, flood had come upon the city, death and duaster threatened the inhabitants. Outside the telephone building people had long since sought refuge; the water mounted higher and higher; fire broke out m nearby buildings. But still the man at the test board stuck to his post; keeping up the lines of communication: forgetful of self; thinking only of the needs of the emergency,

On a higher floor of the same building a corps of telephone operators worked all through the might, knowing that buildings around them were being washed from their foundations, that fire drew near, that there might be no escape.

It was the spurit of service that kept them at their work-a spirit beyoud thought of advancement or reward—the spirit that animates men and women everywhere who know that others depend upon them. By the nature of telephone service this is the avery-day uptrit of the Bell System.

The world hears of it only in tunes of emergency and disaster, but it is present all the time behind the scenes. It has its most picturesque expression in those who serve at the switchboard, but it animates every man and woman in the service.

Some work in quiet laboratories or at desks; others out on the "highways of speech." Some grapple with problems of management or science; some with maintenance of lines and equipment; others with office details. But all know, better than any one else. how the safe and orderly life of the people depends on the System-and all know that the System depends on



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W. B. & J. E. BOICE

Memo Pad

What I will need to make a good tube set

A Kellogg No 501 variocoupler

A Kellogg No 605 variable condenser

A Kellogg No 2 tube socket

A Kellogg No. 505 miniature condenser

A Kellogg No 503 mounting A Kellogg No 609 radio resistance

A Kellogg No. 502 dial A Kellogg No. 69A head set A Kellogg No. 501 rhoostat

A Kallogg switch and switch points

A and B batteries and cabinet

A Datector tube

Kellogg radio equipment is recommended for several reasons

First - It is easy to install and simple to operate

Second - It is built of the highest grade material to give the best possible results

Third -- It is electrically and mechanically correct and will last a life time.

Fourth - It is built by the Kellogg Switchboard and Supply Co , who have manufsotured high grade telephone equipment for the past 25 years.

Fifth - Every Kellogg radio part is CUARANTEED by the manufacturer.

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See there at your dealer's.

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-that eyes may see better and farther

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THE view up the rushing stream, the hole on the far side of the lake where the bass bit so well last season, the awkward heron just aheadall outdoors is within reach through these powerful

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BETTER SHOP METHODS

Simple Threading Method

(Continued from page 89)

behind his lathe, and it was on this rod that the foreman had shown him what fit was required to pass inspection. Reaching over, he set his calibers and finished the thread to this size without trying the gage. Then pulling away the tail center, he tried on the gage, much to the wonder and amagement of the workmen around him. and called the foremen to see whether the fit was correct. With the job finished at 3 o'clock both men and foreman knew that their new buddy was a real workman.

Later Frank explained his system of

threading as follows

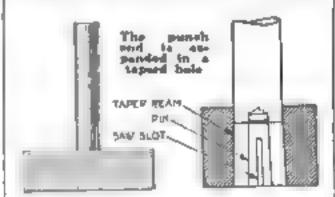
"Set your compound head at 30 degrees." he said, "and throw in your gear and screw and make a light trial cut, and check for pitch. Grind a roughing tool to cut only on the forward or sell hand side, and mp out the thread with a few cuts. Since the tool is ground with a good lip, it will cut freely, does not tear like the usual tool, and makes beavier cuts possible.

"When the thread has been roughed out almost to asse, change tools and finish down the right aids of the thread with the flat side of the finishing tool. Upon reaching the bottom, change over and finish the left side of the thread on the sides rather than on the root diameter. This side, or pitch line measuring for diameter, is far superior to any other way in checking or measuring the diameter."

He used broad feet on his calipers, which bottomed on the sides of the threads as shown. In this manner, if a lathe hand has a perfect sample to go by, he can readily caliper the sides of the thread and duplicate the size on his own work.

Pin Fastens Piercing Punch to Ita Holder

DIERCING punches are usually held with a setscrew, or the punch is beaded over the end. I follow neither of these methods, but ream the punch holder with a



taper reamer for about 1/4 in. from the back. Then I drill a hole in the end of the punch and slot the punch with a backsaw, us shown.

A pin is driven into the hole in the punch to expand the end, so that there is no chance. of the punch's pulling out. -- 8. L. ROHERTS.

Length of Rolled Belting

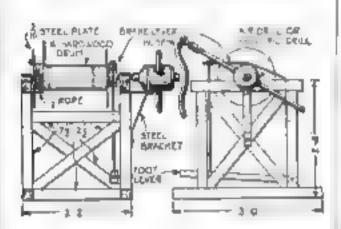
TO COMPUTE the length of a roll of belting, measure the distance from the outside of the roll to and past the center as far as the first inside turn; in other words, the radius of the roll, plus the radius of the central hole. Then multiply by the number of turns and multiply the product by 2618 .- J. R. MOORE, Terento, Can.

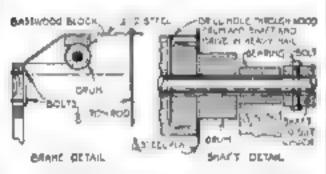
Winch for Light Work Operated by Air Drill Motor

FOR hoisting corrugated steel we use a winch operated by an air drill motor, although an electric drill motor would serve the purpose just as well. The winch was built because the housting engine is usually occupied with beavier and more inportant

BETTER SHOP METHODS

The method of mounting the drum and motor, constructing the bearings, and arranging the brake are sufficiently illustrated



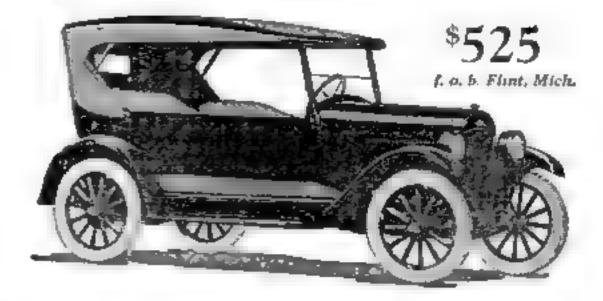


Front and side views of the winch and details of the brake and shaft

in the accompanying details. If an ordinary air motor is used, a three-way cock should be placed at the connection to the air hose and opened to the atmosphere when the rope is being lowered. This will relieve the back pressure and allow the rope to descend much more rapidly. Should a double-acting air delli be used, however, the three-way cock will not be necessary HERBERT A. STRICKLER, Buffalo, N. Y.

Closing Door of Stockroom Cuts Off Electric Lights





What Transportation Means to Civilization

Civilization is the result of interchange of indsvidual thought and the product of thought.

This interchange depends entirely on transportation.

For transportation of products or people in the mass, major transportation units such as ships and railroad trains are most economical, yet limited to fixed ocean lanes or tracks on the land.

The automobile has passed the railroad in passenger transportstion, and will soon surpass it in transportation of merchandise. It is not limited to mass movements nor fixed routes, but oper

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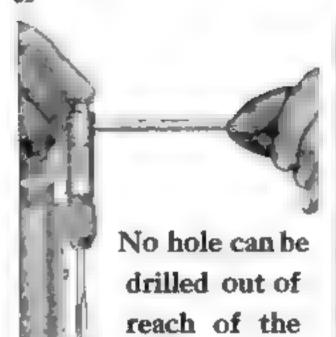
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The "Yankee" Tap Wrench has the same Ratchet movement found in the famous "Yankee" Drills and Screw-drivers. A finger touch on the ratchet shifter gives you right hand, left-hand, or rigid adjustment.

Friction device holds slating cross-bar central, or at either end Bar can be removed entirely for packing in tool box.

Knurled head makes it easy to start or back out taps quickly with the fingers.

No. 250-Length, Jul in. Diameter of chuck, 34 in. Holds up to J/16 in. taps.

No. 251—Length, 5 in. Diameter of chuck.

7/8 in. Holds up to 5/16 in. tape.

No. 1251—Length, 13 in.—for work recouring long reach—otherwise same in No.251

Some other "YANKEE" Tools

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YANKEE TOOLS Make Better Mechanics



Home Workshop

Colonial Desk Richly Repays Building

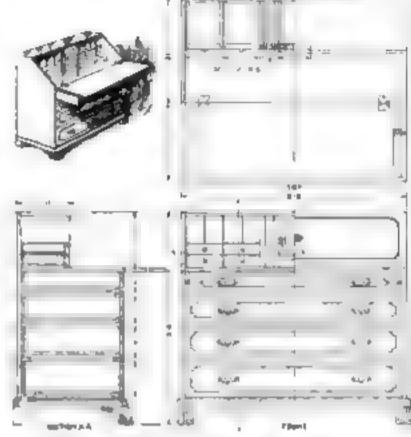
better in your home than the Colonial writing deak illustrated at the right. Combining utility with beauty to a superlative degree, it is the type of furniture that becomes more attractive as age deepens the color of the wood, and the polishing of long usage makes the surface richer and more varied in tone.

Draigned after a genuine antique of especially fine proportions, this deak is 3 ft 6 in high, 3 ft 8 in. wide, and 21 in. deep. The drop leaf is supported by two pulls.

There are four large drawers and ten small ones, two of the latter being concealed behind the door of the "safe" compartment in the upper case Alongside this compartment are two narrow, vertical document cases with blind fronts that make them, when properly fitted, quite inconspicuous. These can be fitted with secret locks if the builder withes.

Solid mahogany is used for the visible parts and whitewood or other inexpensive stock for the unseen portions of the frames and drawers. Although the details follow the Colonial construction in the use of solid stock throughout, three- or five-ply veneers can be substituted for the drawer bottoms and elsewhere.

The inlays add largely to the beauty of the desk but can be omitted, if it is not wished to spend the time necessary to apply them. The front feet can be carved with very little difficulty, and there are two ways of doing it. The easiest is to rough out the feet approximately to the shape shown and then carve them by



Details of writing dock based on see of the simplest and most besutiful Calunial anodels. Home Warkshop Bluoprint No. 31 contains the complete bill of materials

bollowing with a gouge. The other is to carve them in high relief so that the curves are rounded out instead of in.

The hardware should be brass or bronze

and Colonial in design

A desk such as this deserves to be French polashed by a professional, but good results can be obtained by the amateur if the inlays are shellacked, the wood stained with dark mahogany, and six or more coats of very thin orange shellac rubbed with pursice, rotten stone, and oil.

A complete bill of materials and the more important constructional details are contained in Blueprint No. 21 in the Home Workshop series.

will fit into 14-in. grooves in the rails and stues. The frames are screwed to the back and are fastened to the front stiles either by tongue-and-groove joints or butt joints secured with small finishing nails. Either do reied or mortue and tenop construction can be used.

The back has two nerrow panels 10% by 24% in, and one large central panel 16% by 24% in. The construction of the front is made clear in the Austration. The beards are 11 ft. by 2 ft. 2 in.; panels 9% by 22% in

Each pedestal contains a locker with abelves, although sometimes it is worth while to make drawers, as shown in the circular insert. When space is at a premium, close up one of the compartments in front and leave it open at the end for book abelves, as shown in the other insert. The front of the shallow drawer in the center is 3 by 20 in

Complete details of this deak and a bill of inspectals are contained in Home Workshop Blueprint No. 20.

Combination Desk, Cabinet and Book Rack Occupies Small Space

BY THE use of wellboard panels, the construction of the combination cabinet, writing desk, and buck-rack shown on page 94, is simplified and the cost materially becomed.

The deak was designed with the needs of a high school or college girl in mind. For her use it is particularly appropriate, but it will prove serviceable in almost any home

The construction is most ingenious, so that the deak can be made with the fewest possible tools and in the simplest way. It is really made in three parts boded together, and it can be taken apart for convenience in moving about.

The silding deak top has strong, next, smooth-working slides made by screwing two strips of flooring to the sliding

(Continued on page 94)

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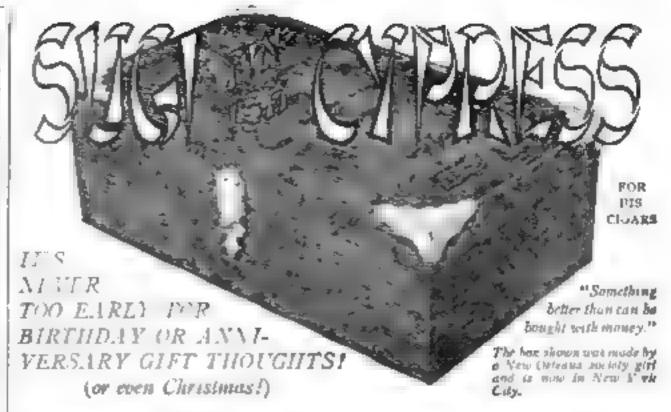
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Combination Desk and Cabinet

(. unlinued from page 0.7)

top in such a way that the tongues fit into grooves of two other strips of flooring screwed to the frame that connects the two cabinet ends.

The end sections are made high so that clothes may be hung in them if there is a shortage of other closet room, in which ease two light rods should be suspended from the tops of the compartments to support skirt and wasst hangers. Any arrangement of shelves, compartments, or even drawers can be worked out to suit the needs of the person who is to use them. Either doors or curtains may be used to close the end sections.

The general method of construction is the same as if wood panels were used, ax-



cept that the plowed grooves must be made to suit the thickness of the wallboard. Both the outside ends are made alike and the two inside partitions are alike.

The ornamental strip or apron on the under side of the front of the sliding top serves as a handle by which to pull it out and at the same time conceals the frame that supports the guides.

The book-rack is made separately and screwed in place at the back of the writing top, just far enough above the sliding top so that the latter can pass underneath.

In assembling the cabinet, the two under sections are placed about the correct distance apart, the connecting frame is slipped into place, and four bolts are tightened to draw the whole firmly together.

The outside dimensions are as follows: Full width, 2 ft. 4 in.; width of ends, 1 ft.; width of ends, 1 ft.; width of center section, 1 ft. 4 in.; height at ends, 2 ft. 10½ in.; height at center, 2 ft 5 in.; depth, 1 ft. 8½ in. The sl.ding top is 16 by 20 in., and the cabinet tops are 13½ by 22 in

By actual test wallboard has proved to be an excellent material for panels of this kind. The possibilities of decorating it are almost unlimited. It can be obtained in several different finishes, and many varieties can be painted. This permits the use of stenciled ornament.

If the woodwork is oak, a particularly effective finish is obtained by staining it dark oak, painting the panels a soft gray green, rather light in tone, and standling or painting freehand the decorative spots or lines a rich dark red, somewhat grayed, with perhaps a few small contrasting touches of green, a little lighter and brighter

than the background color of the panels.

The working drawings of this piece of furniture form the subject of Blueprint No.

22 in the Home Workshop series.



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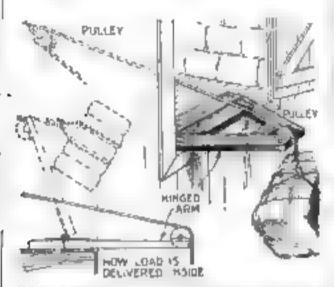
POPULAR SCIENCE MONTHLY

225 West 39th Street,

New York City

Hinged Arm Delivers Hoisted Load within Barn

HINGED extension supporting the A hout rope, as illustrated, is a practical means of lifting hay and other supplies to a barn loft or other structure. It serves the purpose of the usual hoited arm that ordinarily supports the pulley when the load is being lifted, in that it keeps the



When haisted, the load spings automatically

load clear of the wall, but the real advantage comes in delivering the load,

After the land is drawn to the full height of the pulley, a further drag on the hoist rope picks up the load and entries it inside. the door. This saves time and eliminates the danger of accident caused by reaching outside to draw in the load .- A. C. P.

Cleaning Polished Furniture

NEVER wash fine varnished furniture with soapy water. The alkali in the soap will in time damage the finish.

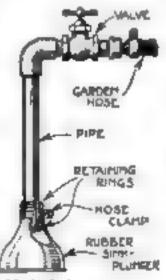
A good wash for even the floret French polished furniture is 2 tablespoons of crude supporte acid and the same amount of paration in a pint of water. Shake well before using, and wash the surfaces lightly and evenly, a small part at a time, drying immediately,

Cleaning Clogged Drains with Water Pressure

ATHEN difficulty is experienced in keeping drains from becoming clogged, a simple device may be con-

structed in the home workshop to utilize water pressure in keeping them open. It consists of short engths of pipe, a valve, a length of garden hose, and m rubber ø.nkplunger connected to one end of the pipe with a hose clamp.

In use the plunger is applied to the drain opening so as to get as tight a joint as



Method of

possible, and the water is turned on. The pressure will flush the elogged trap and clear the drain unless the obstruction is exceptionally deep sented.—C. F Guman, A Big Stride heostat

> principle in filament rheostat construction and radio takes another BIG step forward.

No longer is it necessary to turn a "hair's breadth" to tune in that elusive station, for with the AUTO-STAT you can give the knob a substantial turn and get a superfine adjustment. No other rheostat to date possesses the necessary "fineness" of adjustment to eliminate interference and "tube howls" under all conditions. But the AUTOSTAT, with its

HE AUTOSTAT presents an entirely new

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Two parallel mounted resistance tubes are connected in series by a "micrometer-operated" slider-the length of wire in circuit depending upon the location of this movable slider. Forty turns of the AUTOSTAT knob are required to complete the variation from minimum to maximum resistance against one-half to three turns on others.

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Order a carton of AUTOSTATS from your HOMCHARGER jobber TODAY be the first in your locality to "cash in" on what is destined to be radio's fastest-selling filament rheostat. If he can't supply you, write us direct.

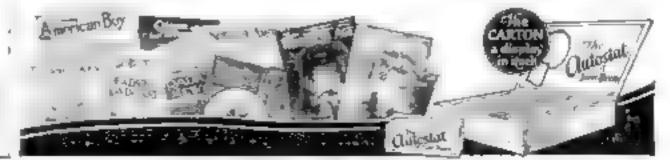
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Day-dreaming led many a man to make plane that brought him big success. Don't be askamed when your thoughts are wandering away when you dream that you are a leader of mee — a doer of hig things in the business world—a builder of leating structures. Your day-dreams are an indication of your ambinous Your day-dreams are an indication of your ambinous and of your desire to accomplish things. The man who never desire has no imagination, he will not get very far. But you can make your dreams real—Tou can materialise your ambition.

Just drawing alone won't do. Hitch your frames up to facts and you will go far. You will get the facts through special training along the line in which you want to succood. And the place to get just that training is the American School. That is proven by the quarter of a century of successful experience we have to beloing many thousands of men and wurses gain an envisable place in business and social life. Another teason who the American fictual is the pines to get your training—it is not a huntrum corporation but a Char-tered Briocklonal Institution, incorporated ant for graft.

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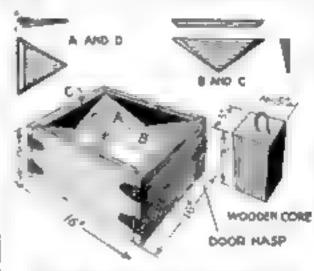
THE HOME WORKSHOP

Ornamental Concrete Blocks Quickly Cast in Wooden Mold

By Dale R. Van Horn

WHEN a few concrete blocks other than commercial pixes are required for masoury work about the home, shop, or farm, it is often possible to east them quickly and easily in a wooden mold. The mold illustrated is one used by a bandowner who wished to add substantial yet attractive gateposts to a drive and to build four corner posts for a lawn fence,

Two I-in, boards 8 by 16 is, and two 8 by 14 in. were used for the outer forms. The pieces were fastened together with hinges, except at one corner, which was provided with a hasp and staple. The mold proper was made of 16 triangles. Eight of the shape marked A-D were 8 in, long and 7 in. high. The S like that marked B-C were 14



Triangular shoped pieces are applied to the Ineids of the mold to give the evenual blocks on ernomental appearance

in, long and 4 in, high. Each plees was planed down from a full size 1-in, thickness at the base to 16 in. at the point. They were nailed to the outer form with finishing noils, care being exercised not to mar the surface in any way. The vertical edges were mitered to fit at the corners where the form was closed.

A core was made from a block o in aquare and 8 in, long, with a bi-in fron rod bent U-shaped to serve as a handle. The sides of the block were tapered to 4 in. square at the bottom to facilitate its removal.

The mold was set on a smooth surface and filled with mortar after the core had been put in place. The mortar was tamped down well and amouthed off on top. The hasp was then unlocked and the sides swung away from the green block.

The same principle may be used for producing various types of blocks and faces. For instance, a good cobblestone effect can be obtained by using a lining of four sheets. of galvanued from dented irregularly with a ball-peen hammer. Wooden strips can be used for producing panel effects.

Giving the mold two or three coats of vazuah or thoroughly ciling or greating the made is recommended but not necessary. If not done, at least wet the mold thoroughly before placing any concrete in it.

Testing Sand for Concrete

WHEN mixing concrete, be sure that the sand you are using is of good quality. Test it by stirring a little in a gians of water. If it leaves the water clear in acttling or with little discolorstion, it is usually excellent for use with cement.



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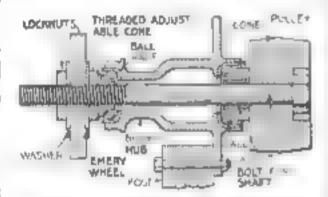
Collawer Building



Automobile Front Wheel Hub Forms Bearing for Grinder

GRINDER with hall bearings that will give much better service than one mounted in makeshift bearings made from pipe fittings, can be assembled cheaply from a discarded automobile front wheel hub A bolt is used for the mandrel and a block of wood for the pulley.

The necessary parts usually can be picked up from the scrapheap, and the only cost is in having the holt threaded to suit the outside cone and locknut. To assemble the



Sectional view of the hub, fitted with a balt for a spindle and a weeden pulley

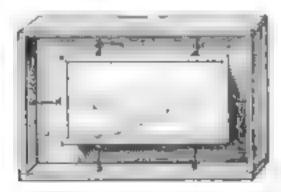
grander, the pulley is made fast to the bolt, the large cone is then all pped over the boit and centered squarely, and Babbitt metal is poured into the space between the bult and the cone. The parts are then assembled as a regular axle spindle, with the exception that two large washers and an extra nut are used to clamp the emery wheel, saw, or other wheel

The post or pillar for mounting the mandrel may be an upright plank with one large hole and several smaller once to suit the holes in the hub. After the stand is mounted, a small rope can be wrapped around the wheel end of the bolt by a helper and used to turn the mandrel, while the builder of the machine trues up the pulley with a chisel or gouge held against an improvised tool rest. F. R. KIEDINGER, New Orleans, La.

Shipping Case for Pictures Hee Rubber Shock Absorbers

THE shock absorbing shipping case illustrated is one I designed for valuable pictures. It meets all the requirements of modern transportation and is being used by one of the largest advertising firms in the world.

A stondard case is built around the pieture or object to be shipped. Heavy rubber



The ploture is suspended by strong electic bands, twisted hight by means of screwsyste in the case

bands are fastened to the case and to the frame or to blocks attached to the frame or other article. The acreweyes used for this also serve as turnbuckles to tighten the rubbers. The method is especially useful for shipping pastel and charcoal drawings. -WALTER S. J. THOMPSON, Brooklyn, N.Y.



When every hour counts

BILL wanted to make his radio set as quickly as possible. But at the very beginning there was a delay in getting his panels. It wasn't a long delay, but he was impatient and wanted to make every hour count.

You, Bill, and every radio serbuilder can avoid such a delay by getting Celoron Standard Radio Panels. You don't have to wait for your panel to be cut. There's no extra expense for cutting to your order. You go to your dealer and give him the size. He has a Celoron panel which you can carry home with you at once.

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Make every hone count in making powered to set. If your radio dealer has not yet suched these ponets, ask him to never for you. Or write direct to us. To sure to designate by number the plue you trust,

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For operating WD-11 Tubes

The Red Seal Radio Sparker

Lasts nearly 3 times longer

The Red Seal Radio Sparker in especially designed for operating the W D-11 dry battery tube For instance, a 2-cell Radio Sparker will give longer service-nearly 3 times longer than a single cell. Radio Sparkers are specially designed for radio use. Connections between cells are soldered insuring perfect contact, Remember the name - Radio Sparker.

The New Manhattan Genuine Bakelite Line

In the new Manhattan Variometer and Variocoupler, Genuine Bakelite gives highest insulation and freedom from mechanical troubles. The amount of metalswed has been reduced to a minimum, electrical losses are therefore low. A Hakehte mounting block permits installation on metal panels, Heavy "pig-tails" ment positive contact and Nariocoupler quet speration g ver complete control up to 700 nicters. Variometer has wave length of 170 to 490 meters.

Machattan Sakelite Knobs and Dals precision, quasty, perfect a lignment, extreme y fine

clear engraving. For quality matruments, ask for Manhattan Genume Bakelite when buying variocouplers, variometers, knobs and dials

For Ignition — Use a Red Seal Sparker -steel clad

It has a heavy, monture-proof steel container. With ands roughest usage and delivers a hot, dependable spark. A perfeet battery for ignition uses,



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Vew York St. Laule

Chicago

Powerful Radio Set for the Loudspeaker

Y SET doesn't give enough volume on the loudspeaker," is the complaint of many radio fans

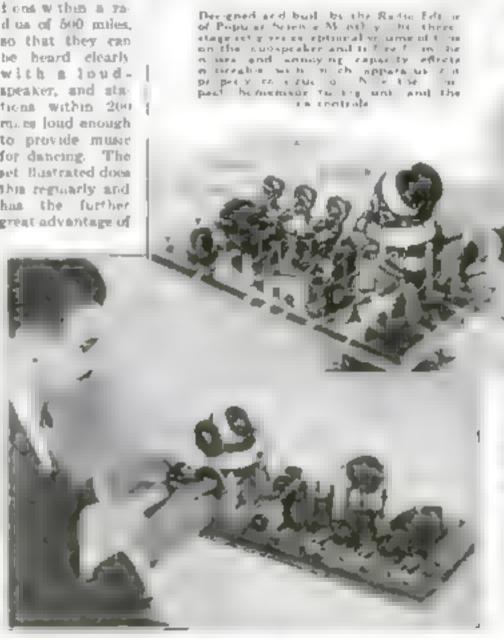
with two-stage receiving sets.

Usually they healtate to add another stage of audio frequency, because it is commonly supposed to introduce nomes. that make clear reception difficult. But the results of considerable experimenting have convinced me that a well designed three-stage audio frequency set will bring

in, without some distortion, stations within a rad us of 500 miles, so that they can be heard clearly with a loudspeaker, and stations within 200 ra, es loud enough to provide music for dancing. The pet Busyrated does thin regularly and has the further great advantage of

tube is 4 in, in diameter and 3 4 in, long. The two rotors are held in position, as shown, by four bearing pieces of 1/4 by 1/16 in, brass. Each piece has one 14-in, hole drilled 14 m from one end for the shaft and two holes at the other end for fastening it to the statur tube.

The distances between centers of the shafts of the rotor tubes should be such that the rotors will not touch each other as they are rotated. A collepring is wound



around the rear end of the shaft of Far to the best 4 1 4 the property of semple of the which they may be placed. Washprin are morried at the front of Lon shafts to recler the roting with respond to the pinfor line

to attchor the rotor windings.

two screws are used, as shown, and one end of the winding is soldered to one screw and the other end to the other screw. Two insulated flexible wires are then soldered to the screws and led to the outside through the hollow is in rotor shaft and fastened to acrews put through the stator tube. The connections leading to the other instruments are taken from these points.

The rotors are prevented from being

All the set, except the batteries, is mounted on a 12 by 24 in, board. homemade tuning umt, illustrated in detail on page 99, is so constructed that the 360- and 400-meter stations are brought

mues.

being simple to operate and not very much

more expensive to assemble than an ordi-

nary two-stage set. It is not critical in

Thu set in New York with a 55-ft

single wire aerial stretched along the edge

of the flat roof of a three-story bouse,

brings in Davenport, Is., so as to be clearly

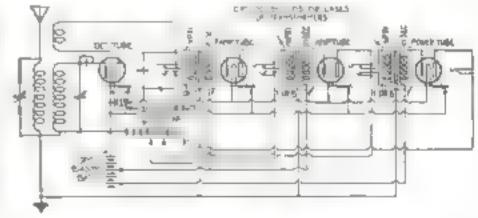
understood on a loudspeaker that has no

battery. The dutance is about 90%

tuning and yet given high selectivity

in merely by the action of a 7-plate primary variable con-

The composition of bard rubber primary



Hook-up of the set which employs a detector tube, two amplifying tubes and for the last stage of amplification, a power tube

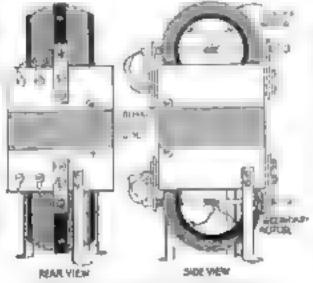
turned through more than 360 degrees by soldering a stiff piece of heavy wire to the rear end of the rotor shaft, as shown, the rear outside screws through the bearing pieces being left long enough to serve as stops.

In mounting the bearing pieces, the boles for the screws are countersunk slightly on the inside of the stator and flat bend screws. are inserted with the heads on the inside. The acrews are held in place by nuts on the outside, placed between the stator and the bearing pieces. The bearing pieces are fitted to the rotor shaft, so that it will turn freely, and mounted in place. When mounted, the rotors are centered correctly, and the outside nuts are placed over the bearing pieces and tightened.

The primary should be wound with 30 turns of No. 20 or No. 22 single or double cotton or silk covered wire and the ends anchored, as shown. The rotors are then mounted.

To fasten the rotors to the shaft, all that is necessary is to flatten the part of the shaft that fits into the soud part of the rotor so that the cross section at that point is slightly elliptical. The shaft can then be forced into the rotor to make a firm force fit and hold the shaft and rotor together without the necessity of keys or pins. The top rotor is used as the tickler coil, while the lower rotor is the secondary cell.

A 5- or 7-plate variable condenser is used as a primary condenser, while an 11- or 23-



Details of the tuning unit, which con-sists of a stator tube with fixed primary winding and two reters

plate condenser serves as a secondary condenser. Condensers with more plates can be used, but those mentioned will give closer tuning and, consequently, better results. Condensers, rheostats, and jacks can all be board mounted if small angles of sultable size are made of 🎉 by 1/16 in, brass or other strip bram, drilled and bent m required.

Much of the bowling and other poises beard in receivers are due to faulty wiring and location of the parts. You will notice that the tube nockets I the set are not placed in one straight line, but staggered, and that this makes it possible to increase the distances between the transformers. These distances are also slightly increased by mounting the second transformer on a sort of elevated platform. This separates the fields of the transformers from each other so that their effect upon each other is reduced to a minimum.

The terminals are placed so that the grid leads are as short as possible. The shurter these grid leads are, the less will be the chances of the howling effect frequently (Continued on page 100)



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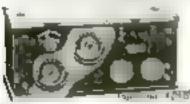
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THE MIDWEST RADIO COMPANY 609 Main Street, Cincinneti, Ohio



THE HOME WORKSROP

A Powerful Radio Set

(Continued from page 99)

due to the plate currents being fed back into the grid circuits.

In wiring the set, start with the filament circuit and run the wire from the A battery terminals shown to the extreme right in the front view on page 98. The wire from the front terminal connects one terminal of each rheostat, while the wire from the other terminal connects one terminal of each tube socket. The free terminals of each rheostat are then connected to the free filament terminals of their respective tubes. Care should be taken hat an few wires as posaible rup parallel to each other. All connections should be soldered wherever possible.

The wiring diagram will show you that use is made of a grid biasing battery, the correct value of which is found by experiment. This battery may be made by connecting several flashlight cells in series of a small 22 14-volt B battery can be used by connecting the positive 22 14-volt terminal to the negative of the B batteries and attaching the accondary F terminal of the transformers to the other positive variable tape. In some transformers one terminal of the secondary is marked P, while in others it is marked B. Where no marking is found, this terminal is the inside and

A soft detector tube is used as a detector, standard amplifier tubes are used in the first and second stages, and a power tube is used in the third stage. While not absolutely necessary, the use of a power tube in the third stage gives much better results, While the usual power tube can be used with a 6-volt storage battery, the maximum efficiency is obtained with an 8-volt one,

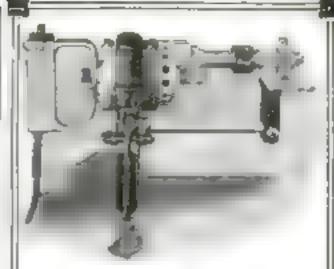
The plate voltage on the detector should he about 22 volts; on the first and second stage tubes, from 45 to 100 volts, and on the last stage from 100 to 300 volta

The negative bias on the first two amplifier tubes can be adjusted at the same time. the two secondaries of the transfermers being connected together. This voltage will vary from 1 to 6 volts, while the negative voltage on the last tube may vary from \$ to

The tuning of the set is simple. By turning up the filament until a rushing sound is heard and varying the primary, secondary and tickler adjustments, the characteristic whistle is heard. The controls are then manipulated until the zero beat adjustment at the lowest pitch of the whistle is found on each adjustment. In order to minimuse further any possible chance of howling due to the interaction of the transformer fields. a wire should be connected to the cases or framework of the transformers and then grounded. Grounding the lead that goes from the secondary of the tuning unit to the A battery also has the effect of stabilizing the set and preventing possible nones. In connecting the condensers, the rotary plates should go to the grounded side of the circuit, in order to avoid any capacity effects when making adjustments.

Care must always be taken that the A battery is fully charged and that the B batteries are in good condition.

If you have alternating current in your home, the best investment you can make is to matall a battery charger so that you can keep the battery fully charged all the time. The cost of charging the battery at home is less than one fifth what you would have ordinarily to pay to get it charged at the service station. THE RADIO EDITOR.



A Complete Machine Shop In One Tool

The Jenes Electric Drill can be clamped to a beach, and by means of the attachments. can be used for grinding, polishing, buff-ing, sawing, or light milling, counter-boring, etc. It's just the tool for home use powerful, compact drilling up to M" thru steel. This drill is 10" in length, net weight the and is fitted with a No. 1 Jacobs thank. It seems for the unsmally low rates of \$25.00 without attachments. Attach-Write today ments at slight agoltions, eighor tokler which completely describes this most desirable tool.



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Old Electric Light Bulb Is Dependable Weather Man

A WEATHER forecaster of unusual but almost abstirdly sumple construction can be made from an old electric light hulb.

Immerse the bulb in water that has been colored with a few drops of red ink and clip off the tip under water with a pair of pliers. The liquid will then fill the bulb and remain in it when the lamp is lifted out.

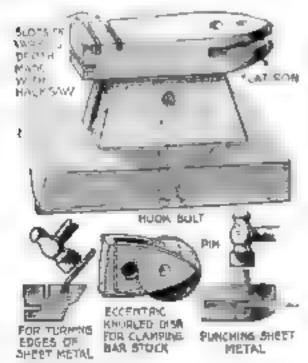


Hang it up as shown by tying a piece of cord or bending a length of wire around the threads of the base. Beneath it place a clean blotter

A decrease in the barometric pressure will cause a drop of the liquid to cope out at the tip and drop to the blotter. Hence, whenever there is a spot on the blotter, one may expect rainy or stormy weather. It is advisable to make this contrivance when the atmospheric pressure is high.—A. J. D.

Flatiron as Useful Bench Fixture and Anvil

THE home worker can provide himself with a serviceable anvil and bench fixture for light work by rigging up a heavy flatiron as illustrated. It is mounted be-



Slotted, drilled, and mounted, a flattron serves for much light metalwork

tween two blocks and fastened to the beach by means of a hook bolt fastened around the handle and drawn tight from beneath

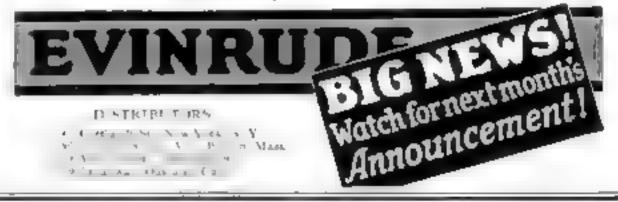
Slots of various depths can be cut in the top surface and at one end to serve for turning the edges of sheet metal, and the point can be used as a punching fixture for clamping bar stock, and the like.—G. A.



Evinrude now offers a complete line of small-boat motors. Evinrude Detachable Motors come in both single and twin-cylinder models—2, 3½ and 4 H.P. For cance installation there are the "built-in" Evinrude Inboard Motors—single and two cylinder.

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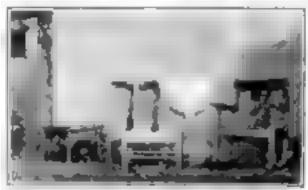
THE BOME WORKSHOP

How I Make Money Converting Scrap Lumber into Furniture

MY EXPERIENCE in making furniture in my spare time has shown that it is a profitable pastime. If good judgment is used in the purchase of materials, any one who is handy with tools should not about 30 cents an hour for the time actually spent at the bench.

I have found the field for doll furniture particularly good. Every sale brings new customers and when one article is sold, the buyer usually wants other articles to complete the set. In my work I make use principarly of odds and ands of weste material left over from housebuilding, such as pieces. of base, tram, flooring, iath, sheathing, aiding, wood veneer, and even packing boxes.

Before the bouldays I disposed of much children's and dolls' furniture such as eradies, high chears, dining-room sets,



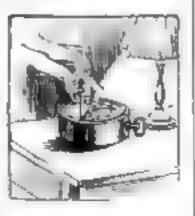
Play furniture for children, the size of which can be estimated by sampersons with the sleer at the left

kitchen tubinets, rocking chairs, and beds In the better class furniture I have made telephone stands, costumers, footstools, plant stands, sewing backets, and window

On the whole, a line of small furniture is easily manufactured and selfs at a better profit, I find, than the higher grade of furniture. It is not necessary to be a mechanic to make pieces such as those illustrated. For instance, in the case of the chair, the rungs are nailed through with small finishing nails or brade, the seats are fiber purchased at a five and ten cent store, and the slats are waste lath dressed to size. The finish consists of turpentine or gasoline and asphalt, burnt umber, drop black or other suitable colors, with a cheap grade of vernish. I find it pays to watch the toy catalogs for attractive designs and select cars that promise to be best sellers. Then I make a sample and perfect it so far so possible. This I dismantle, thing it as a pattern for making a dozen or more like it.-JOHN BUTCHER, Niles, Mich.

A Way to Start Small Screws

CO START into their holes tiny screws such as are used in watches, clocks, and other smail mechanis not en difficult, because it a pest to impossible to hold them. with the fingers when setting



them in place This difficulty is easily overcome by forcing the screw through a small strip of paper and using the paper as a handle for setting the screw while starting it with a screwdriver - C. J. WATTERS.



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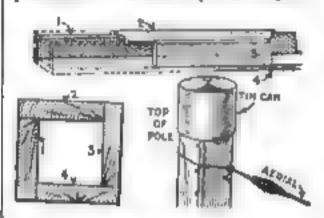
\$1.00 What every young husband and Every young wife should know What deep parent should know Clab hading 120 pages may President Postpaid AMERICAN PUB. CO., 417 Window Mile., Philadelphia



Tall Aerial Mast is Built with Interlocking Wooden Strips

THE writer has had in use for some time an antenna pole 35 ft. high made of wood as illustrated. Despite poor insterial and indifferent workmanship, it withstands high winds, is apparently in good condition, and supports my serial at an envisible beight. The most combines lightness and strength, because regardless of what side the strain comes, the pull is always against the grain of some part of the wood.

Wooden strips approximately 1 by 21/2 in, by 7 ft. are used. Old packing crates will provide material, or rough, unfinished strips from a lumber yard can be bought. The number required depends upon the length of the strips and the height of the pole desired. For a 30-ft, pole 20 strips will



blaw the stripe are nailed together to form a strong ber and the way the top is supped

suffice, even if parts of some of them are discarded because of knots and defects.

The order in which the strips are nailed to each other is shown by the numbers 1, 2, 3, and 4. Strip No. 2 is nailed on strip No. 1 so that one fourth of the length of strip No. 1 extends beyond the end of No. 2. Strip No. 3 is nailed to strip No. 2, sliowing one fourth of strip No. 2 to remain free Then strip No. 4 is nailed to strip No. 3 with the same allowance and also to strip No. 1, thus completing a box equal in length to one fourth the length of a single strip, at both ends of which are partially attached strips. The continuation may commence at either end, and the other end is filled with short pieces.

Holes are drilled through the sides of the pole at the end intended for the top, and the guys are attached in such a manner that the strain will fall equally upon all of the strips constituting the top of the pole. A tin can is placed over this end to keep out the rain. Two sets of guy wires, one from the top of the pole and the other from the middle, are all the support necessary.—George Frederick, Washington, D. C

What Do You Need for Your Home Workshop?

HOME workers who must buy tools, will usually save themselves time and trouble by looking up the display and classified advertising in Populas Science Monther. If the items desired are not listed in the advertisements, send a letter of inquiry to the information Department, including a stamped, self-addressed anyslope. You can depend upon a prompt reply to your communication.

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How to Make a Vacuum Tube Set for \$20

Continued from page 75)

they can be obtained by making adjustments of the switches and the rheostat, the "tickeer" coil, that is the rotor of the variocoupler, should be turned throughout its range until the best results are obtained.

In making your adjustments you will bear a bowling or whisting noise that changes in pitch, going from a very high, shrill note to a very low note and then stopping and beginning again at a low pitch and going to a high petch as you turn the rotor knob still farther. Always leave your adjustment at the point between the two low pitched notes. If there is no pause, or point. where the howling ceases when the low pitched tone is reached, cut down your tube current comewhat or make a slight adjustment of the switches until you do get a pause where there is no howling.

In making the switch adjustments, the tickler coll should be not at different angles until results are obtained. First try having the tickler coll concentric with the primary coil and move the switches through their whole range. Then, if you do not get results, vary the adjustment of the tickler coll by 10 or 20 degrees at a time until you do get results when making the other adwatersents.

While very good results for a considerable time can be obtained by the use of a single dry battery for the filament current, it is cheaper in the long run to use two batteries connected in parallel or to use one of the special batteries consisting of several cells in one container, which are now being

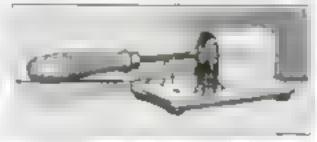
manufactured for use in connection with dry cell tube sets.

By following these directions you can obtain as good results with this set as from some commercial sets costing much more.

Homemade Electric Stove Keeps Soldering Iron Hot

THE soldering iron heater illustrated was built around the heating element from an old electric beater of the reflector type These elements usually can be purchased new for \$2 or less.

The other materials used were: 1 piece of asbeston, 35 by 4 by 7 in., 4 wooden feet, 2 binding posts, I length of asbestos covered



The soldering copper restains ide the per-celain apool of a heating element from an electric heater

beater cord, 1 attachment plug, 1 sheet metal hood, and the necessary screws and

The hood is galvanized sheet from \$14 by 7 in., cut with a pair of tin enips. The point of the soldering tron goes made the porcelain spool of the heating element. It is important to arrange the wire stand so that the bit will not touch the side of the spool. as otherwise the porcelain may become cracked,-J. M Fox.



The lightest Relation was the knowled trust. The Tribbetta

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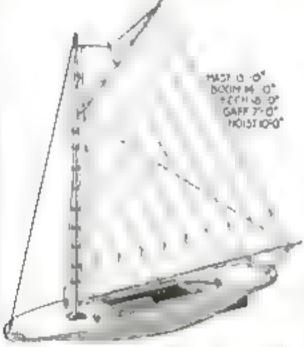
Easily and Cheaply Built Sailing Lark Is Speedy Craft

By Stillman Taylor

THIS little craft is of the light draft, aximming-dish type, and is particularly well suited for a boy's use. Of simple and mexpensive construction, it is very fast under sail, especially in light winds, and yet its relatively wide beam makes it safe and stable. As there are no complicated curves, the boat can be built with a few common took and does not take a great deal of time.

The molds (Fig. 1, page 106) are first made. They can be removed after the hull is ribbed and planked, but it is well to make them in the form of frames and nail





Afthough a fast and safe heat to sail, the lark has a built hat the amateur band-but der can build without difficulty

the planking and decking directly to them, for that insures a very strong hull.

Four molds are required: Nos. 1 and 4 (Fig. 5, are alike and placed on the keel 2 ft from each end: Nos. 2 and 3, also slike, are lucated 5 ft. 6 in from the first two. This gives a 5-ft, cockpit. If a longer cockpit is wanted, simply fasten the top section of No. 8 mold temporarily in place with screwa so that it can be removed and the cockpit extended an additional 18 in aft

When building the moids permanently as frames, saw them out of 2-in apruce or hemlock. If they are used only to give form to the hull while building, make them out of any cheap 1-in lumber at hand.

The sideboards (Fig. 2) are made of Jarin cedar, spruce, or cypress. The keel (Fig. 3) should be 1 by 8 in. oak, or 2-m. spruce, cedar, or eypress.

The stems (Fig. 4) for how and stern are (Continued on page 100)



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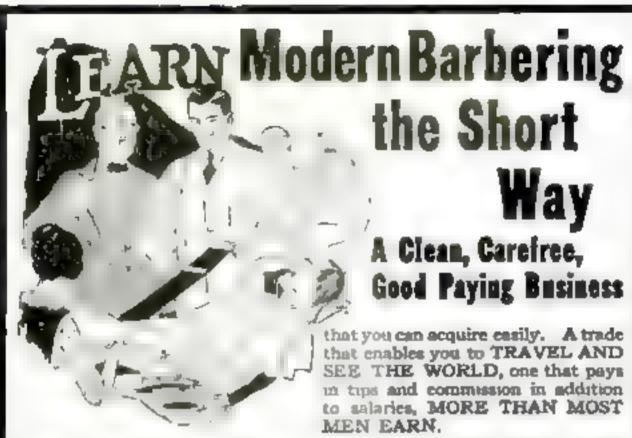
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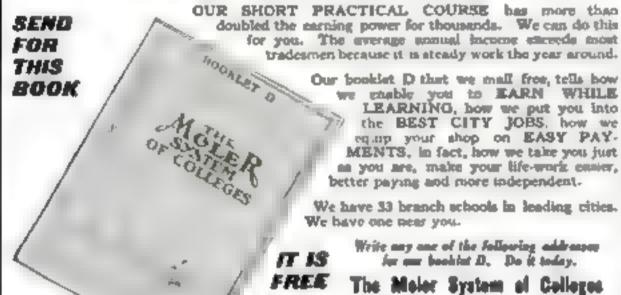
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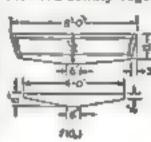
POPULAR SCIENCE MONTHLY 225 West 39th Street, New York City THE BOME WORKSHOP

Easily Built Sailing Lark

(Continued from page 105)

exactly alike. While they may be steamed and bent to shape, the easiest and cheapest way to obtain them is to purchase a half set of rough, unfinished bent oak wagon rima 4 ft. in diameter, 2 in, wide, and 2 in, in depth. All festenings should be made with 1 1/2-in. screws, the heads being countersunk

The ribs can be fashioned from 34-in. oak strips, steamed and bent to shape, or made in two pieces. Equally strong ribs may be sawed out of 12-in, spruce or hemlock. making them in two pieces, fastened by means of a batten strip on each side, and acrewed solidly together. Not less than 10



ribe should be used. it is better to use 13 and space them closer. In Fig. 6 is shows how the ribe are spliced together where they overlap on the keel. For fastening pak riba,



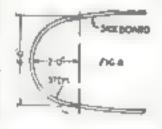
use gulvanized boat nails. First bore through the rib and then from the outside drive nails long enough to clinch well on the inside of the ribs. For fastening the sawed. out frames, use scrows, countersinking the heada.

To plank the hull, turn the frame bottom up (Fig. 5) and fasten the planking at the sterms with screws, and to the ribs and frames with nails. For the planking, order, spruce, or cypress boards, 8 lp. wide and \$6 in, thick should be used. The planking is done by laying the first board next the keal and working out flush with the adebeards. To allow for calking a space of 1/16 is, in usually left between all planks, but a better and tighter fit is secured by planing the edges of the joints to a slight bevel, the inner edges fitting together and the outer being open 1/16 in., like a very narrow V When the bull is planked, give the whole inside a coat of white lead paint,

The mast step or block is a piece of oak I by a by a in., with a square 8 by 8 in.

hole cut in the center. This is screwed firmly to the keel 3 ft. from the bow

The rudder post is located 3 ft from the stern. Bore a 1-in hole through the





How the book and stome are laid out

center of the keel, in this screw a piece of common iron pape threaded at the end. Thus should be long enough to come up flush with the top of the deck. See Figs. 3 and 6.

The centerboard (Fig. 8) is formed by screwing two end posts 2 by 2 by 14 ln. in each end of the 2-in, slot previously cut in the keel. To these the boards forming the casing, or trunk, are nailed after a few strands of candle wick or strips of woolen

Continued on page 197)

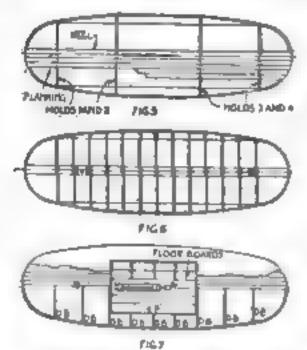
THE HOME WORKSHOP

Easily Built Sailing Lark

(Continued from page 106)

waste are placed along each side of the slot and brushed with a heavy coat of white lead. paint. This will prevent any possible leakage. Paint the inside of the boards while putting the trunk together.

The centerboard is oak or cyprose, the pleces joined with dowels. A single board would soon warp. Galvanised from rode 1/



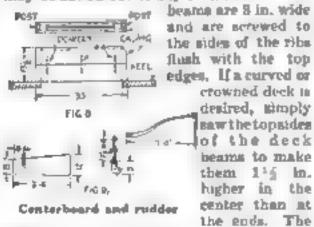
Flow the hull is framed and plonked

in, in diameter may be used for the dowers, but if the boat is to be used on sait water une brane rode.

The board is hung in the case by a bolt running through the casing. Bore a 1-ln. hole in the board about \$ in, from the bottom and 2 in, from the forward edge like n 4.-in, hale through the casing to register with the hole in the hoard and run a bolt through, using large washers. The iron centerboard rod 1, Fig 10 is attached to the after top edge of the board.

For the top of the centerboard case, use a 19-in, hoard with a 1-in, hole bored to allow the rod to work freely up and down. Around the bottom of the trunk, on the keel, lay a few attends of wick or strips of waste, and tack on a 1-in, quarter round molding

Oak strips I in square can be used for the deck beams, but amply strong supports may be sawed out of any 1-in, lumber. All



third deck beam will form the plate for fastening the coaming at the forward end of the cockpit.

Decide upon the length of cockpit wanted and put in the stern deck beams in the same manner. The coaming plate is uswed out of 1-in, stuff, 4 in, wide, and run fore and aft in line with the keel (Fig. 7). To support the side decks, short deck beams made the same width as the longer ones, are runfrom ribs to the coaming plate. All beams and prates should be sol dly screwed

Continued on page 108

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THE HOME WORKSHOP

Easily Built Sailing Lark

(Continued from page 107)

The deck is covered with coder or spruce boards 4 or 6 in. unde and ½ in thick. After fitting each board, it is a good plan to give the reverse side a cost of point before nailing. When laying the side decks, put a few strips of waste along the top edge of the sideboards, cost with thick paint, and nail or serow solidly to the sideboards. Countersink all nail and screw heads and putty up all holes before laying the canvas.

The deck boards should be planed smooth. The canvas is put on dry or in wet paint, but to get a smooth and absolutely watertight deck, lay the canvas in give by brushing black marine give over the deck boards with an old stubby paintbrush, smearing it on as evenly as possible.

The canvas is put on in two sections, the seam running parallel with the heel. Let

the canvas overlap the stem and the cockpit about I in. Then, with a moderately hot flat-iron, iron the canvas until the glue melts and sweats through the canvas. Pull the edges of the canvas over the

Pulley blocks, traveler, and other callboat fittings

stem at how and stem, gather neatly and tack the edges with copper tacks spaced close together. Lay the canvas on the other section in the same way, over-lapping the canvas just laid by 1 in and tack the seam with a double row of copper tacks. The rough edge of canvas on stem and sideboards is covered with a half round molding.

The cockpit coaming is made of \$4-in, boards 6 in, wide, screwed to the plates so as to project above deck about 2 in. To make a nest finish, run a small quarter round isolding around the canvas deck and tack it to the coaming.

The cockpit flooring, of 1-in. stuff, is now acrewed to the ribs. Just aft of the center-board cut out a square hole in the floor between the ribs, so that water may easily be hailed or pumped out.

The rudder (Fig. 8) in of \(\frac{1}{4} \)-in. oak. For the rudder post an iron rod about \(\frac{1}{4} \) in. in diameter is forged as shown. Any blacksmith will do this, and make the tiller to fit, for a small sum. The post is attached to the rudder blads with screws or rivets.

The mast, boom, and gall may be planed out of spruce or bemlock. It is an easy matter to make the space round and tapering by first planing to the desired taper in the square. Then take off the four corners and reduce in turn to make the stick eight maded. The spar may then be acraped round and smooth with a common steel cabinet scraper.

The most is supported with a single wire rope stay running from an eye in the most band to a turnbuckle hooked into an eyebolt screwed into the oak stem. The foot of

(Continued on page 109)



THE ROME WORKSHOP

Easily Built Sailing Lark

Continued from page 108)

the most is cut square to fit the most block screwed to the keel, and to prevent aplitting the thin deck, a block of 1-in. oak, with a hole a trifle larger than the diameter of the must at the deck, should be acrewed firmly to the deck. The most should not be less than 814 in. In diameter from heel to deck and should taper uniformly to about 2 1/4 in. at the most head. From deck to top it is

The boom is 214 in. In the center, tapering to about 2 in. at the ends: the gast 2 in in the center, tapering to 114 in. Both should be at least 6 in, longer than the width of sall to allow for the stretching of the canvas. The best way of attaching the boom to the mast is to use a guosenscit, P. Fig. 10, with a plate to screw to the mast, and a long acrew to acrew into the end of the boom. Jaws, C, sawed out of 1-in. oak and bolted or screwed to the gaff attach this spar to the mast.

How to Stitch the Sail

For the sail 6 15- or 6-on, cotton drill in heavy enough. It can be stitched on the sawing machine. The narrow, bighted effect can be obtained by folding over a lapof the goods and double statching the fold The bights should run parallel with the after edge or leech, as shown in the sail plan. Sow all the breadths together, then stitch in the laps. Run a 1-in hem along the levels and a 1 14-in, bem along the hoist, boom, and gaff. At each corner of the sail stitch on a circular reinforcing patch, as shown

When cutting the sail to shape, be sure to cut the feet sail at end of boom at least 12 in, higher than the soil at the most. This is necessary to give clearance space when the

bourn swings over,

About 18 in, from and parallel with the boom, sew in a row of reef points. Cotton 70pe ¼ in, in diameter is about right for this, the unds being whipped to prevent unra vehnga

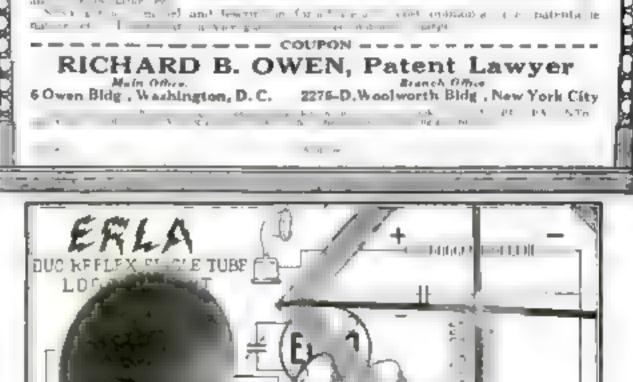
Attaching Sail to the Mast

The sail is attached to the most with unk or metal most hoops, J. Fig. 10, and the boom and gaff are attached by lacing with Unin. cutton cord. Grommet holes are worked in for each must hoop and in the hights or laps of the sail along the boom and gaff sides. To make the grommets, purchase 5 doz. galvanized izon or bress grommet rings, about 1/4 in, in diameter. Punch a small hele in the spot where the grommet is wanted, place a ring on each side of the hole, and new the rings to the sall with waxed sail twine, using an overcasting stitch. Work a row of grommets along the gaif and boom in the same way.

For the meat a band with two eyes is needed B, Fig. 10). Slip this over the top of must and slide it down until it wedges. To the forward eye, splice or sense the end of the 3. 16-in, wire rope stay; in the after eye, hook the sister hook pulley block for the peak haiyards. About 1 ft. below, acrew an eyebolt in the after side of the most directly in line with the eye in most band. Hook another pulley block in this evebolt for the throat halyards. The best blocks to use are galvanised from to take a 14-in, manila rope. On the deck, at each side of the mest,

Contenued on page 116)





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THE HOME WORKSHOP

Easily Built Sailing Lark

(Continued from page 109)

screw a galvanued deck pulley (O. Fig. 10). Place these 12 in, from the most and in direct line with the center of it, and lead the throat balyards through one block and the peak halyards through the other. This arrangement serves to support the most and answers the same purpose as a wire side stays or shrouds. That the halyards may be within easy reach of the steersman, it is a good plan to have them long enough to lead to the cockpit and fasten to cleats screwed on each side of the after end of the centerboard trunk.

In the center of the cak stem at the bow screw in a heavy eyebolt (A, Fig. 10), and in this insert a turnbuckle, G. Seize the end of the wire rope stay to the eye of the turnbuckle, and set the stay up taut. Near the stay screw a 3-in, how check, R, to the stem, so that the mooring line will lead fair. A cleat, L, is always in the way on the forward deck, and it is best to make the end of the mooring rope fast to the mast.

Rigging the Main Sheet

For the main shoet, three single pulley blocks for 14-in. rope may be used. These should be fitted with sister or match books, H, like the others. Two are made fast to the boom, and the third seized to the ring in the traveler, the latter being perewed to the after deck. By using a traveler, E, the sail will shuft without attention, thus saving the bother of shifting from one cleat to another when going about.

The boat should be smoothed with sandpaper and given three coats of white paint. All acrews and nail holes should be puttied after the priming cost. The mast and spare should be protected with two or three coats of outside spar varnish. The coaming may be varnished instead of painted, if preferred.

For mooring the boat, a 20-lb. anchor and a 4-in mooring cable of manila rope will be peeded.

Home Workshop Features that Will Save You Money

ARE you going to build a garage this year? If so, plane for an attractive pergoia garage in next month's Home Workshop.

Mr. Joe V. Rome will tell how to build a small motor unit that performs many tiresome household tasks.

The "Secrets of Making Realistic 'Antique' Furniture," omitted this month because of space restrictions, will appear in May.

What you can do in the way of concrete work about your house and garden will be the subject of another feature.

There will also be the usual helpful and constructive radio articles.



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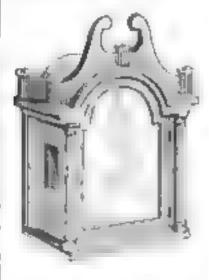
Grandfather's Clock Cases

(Continued from page 76)

cost of blueprinting and handling. Those who wish to make the clock should obtain the blueprint, because it will save much time in getting the stock. It should he noted that the case has been designed to take the largest and most complicated chitring works. For smaller movements the dimensions can be ecaled down as required.

The other designs on page 76 represent varying degrees of simplicity or elaboration. The easiest and cheapest to make is the design marked No. 1, sometimes called a Mission style hall clock. It is 17 2 by 1836 in. and 6 ft. 2 in. high. Number 2 is n mahogany clock 7 ft. 7 in. high, 26 in. wide and 18 in, deep. Number I is 7 ft. 6 in, high, 25 in, wide and 1415 in, deep, and No. 4 is 7 ft. 1 ln., 22 in., and 18 in.

The lawer filustration on page 78 is a magnificent inlaid clock, now in the Metropolitan Museum, New York City, that will



A grandfather's clock capied from one made shortly after the Revolution, with details of the bonnet construction

tax the utmost ability of the home craftsman to copy auccessfully

The case above is another Colonial clock, 6 ft. 8 in. high, 18 g in. wide, and 10 m deep. The majest way to start it is to cut out the back to shape and then add the ends and front. The cut-off corners may be left plain, or fluted or reeded.

The arch at the top of the bonnet is cut on a radius of 7 in and the radius on the top. of the door is 514 in. The top of the bonnet is covered with thin strips of wood glaed to canvas. As in the case of the first clock described, a mahogany mat about 5/15 in. thack is glued to the unide eage of the arch The mu darge can be cut with gouges and cleaned up with samapaper. In old clocks the ornamental urns are ordinarily of brass, hat wood may be used. The cycle that decorates the base is inlay, and, if desired. the space within it can be veneered with a different wood from the remainder of the

Movements and dials for clocks can be purchased ready to be inserted in the case. These range from simple movements that strike the half hours, at about \$5, up to magnificent two-chime tubular movements.

A very popular movement is known as the 'Brack Forest.' It is run with e-ther heavy brass chains and weights or with enameled from weights, and usually is accompanied by a white enemeled wooden d.al, although other dials can be used

More expensive movements have as many as nine-tube chimes.

(Continued on page 112)

CLARENCE A G'ERIEN

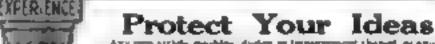
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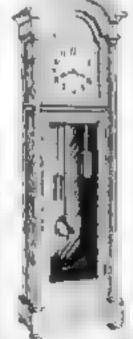
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THE BOME WORKSHOP

Grandfather's Clock Cases

(Continued from page 111)

Dials of many varieties also can be obtained, some of the finer ones being of brass with gold plated corners, enameled etched numerals, lunar arch and movable moon. These can be obtained through jewiers and watchmakers, manual training supply houses and clockmakers. It is advisable to obtain the dial, if not the works, before laying out the case so that the dial will be sure to fit.

If a fine case is made for the clock, it is well worth the additional price to put in a



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THE ROME WORKSHOP

Wire and Ingenuity Provide Many Tools and Fixtures

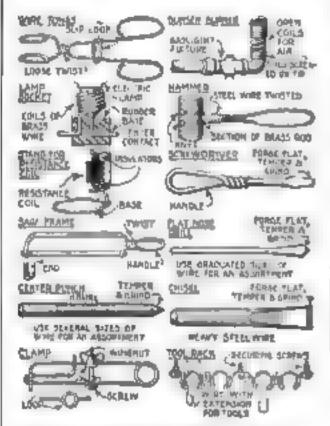
By G. A. Luers

THE usefulness of wire is practically limitless. Tools, fixtures, mechanisms, and devices for innumerable purposes can be made of wire or formed with wire as an integral part. It would be impractical to attempt to enumerate even a small percentage of wire devices. These twelve nactual ideas, however, will suggest others that can be used to equal advantage in the home workshop.

WIRE TONGS—Bent wire forms two sciency-like handles, with a hinge and a sliding catch. These are made of Min steel wire or equally as stiff iron wire, and are useful for sordering, heating, and on

acid work

BUNKEN BURNER—Thus is for a gas fixture. The wire is couled to fit the thread and opened at the center to admit air



These 12 suggestions indicate the many was for wire in the house workshop

Wind the coll close and open gradually until the gas burns with a light blue flame, intensely bot.

LAMP SOCKET—Brase wire is sailed to meet the threads of a candelabra light and attached to a piece of hard subber. The

center contact is brass wire.

HARMER—A short piece of round or equare bram is fitted with a twisted wire handle by drilling holes and forcing the wire ends into place. The ends are then riveted.

STAND FOR RESISTANCE COIL—By bending wire to the shape indicated, a support is made to hold a resistance coil. Insulators are placed at the points of attachment.

Schewbrivers—Hent wire forms the handle. The working end is flattened, hardened, and ground. Several graduated sizes are serviceable.

SAW FRAME—Heavy steel wire is bent as shown and hackenw slots cut for the ends of blades. Frames for metal saws or for fine coping saws may be made to suit any size or style of blade

FLAT NOSE DESLIS—Use graduated sizes of steel wire, forge the ends out, and temper by heating on a Bunson burner and

(Continued on page 114)

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THE BOME WORKSHOP

Wire Provides Many Tools

(Continued from page 113)

thrusting into a potato. Grind the points to a bevel, se on dritte.

PRICK PUNCHES-Use same size of wire as for larger drills; temper and grind to conical points. If a lathe is available, knurl the stems.

CHIERLS-Use heavy steel wire, forgeends flat, temper as suggested for drills, and bevel the point by granding

CLAMP-Bend wire as shown and use a small screw and wingout to obtain pressure. This clamp is useful for holding parts while soldering, breating, drilling, etc.

Tool Rack-This rack is made from a length of wire with bends to accommodate the various tools and equipment.

How to Make Attractive Vases from Old Glass Bottles.

MOST attics and cellars contain a lot of old pickle and fruit bottles, some of which may be put to good use in the following way.

The selected buttles should be washed out and thoroughly dried. A sheet of Iron

is then placed over the gas burner men and the gas in lighted. One of the bottles is placed on the plate and allowed to become bot enough to melt scalingwex when it touches It. Sticks of sealing-war of various colors. which may be purchased at any stationery store,



Calored scaling was in blunded over the heated glass

are melted by contact with the surface of the hottle

If a careful choice of colors is made, some very beautiful effects can be obtained by allowing them to bland into one another .- J. B. MORAN, New York

Inner Tube Serves as Emergency Dipper for Auto Tourist

THEN it becomes necessary to fill a cadiator while on the road, where there is water but no utensil to carry it. look for an old inner tube. If you have one. a section cut from it will hold water and the

valve stem will serve as a carry-W/BE mandit ing handle. The better plan MACE



For dilling the radiator

is to have handy in the car a water CHILIGI IDAGO DO shown, with a handle and rim of heavy wire. Cut an old tube square across, punch a hole in it two or

three luches from

one end and pass the handle end of the wire through it. Then pass the tube through the ring part, earl the short upper part of the tube down over the outside of the ring and sement it. Cut the tube off at any convenient length and rement the lower end. - LOUIS SCHNEIDER, Clinton, Mo.

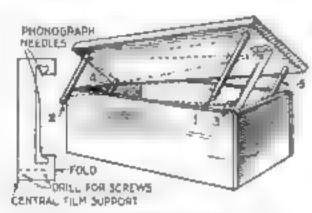
THE BOME WORKSHOP

Cheaply Made Developing Tank Aids Amateur Photographer

By H. C. McKay

IN DEVELOPING films by the tank method, which has much to recommend it, a homemade darkroom tank will often gerve the purposes of an expensive commercial daylight tank. In case the amateur wishes to watch the process of development, as in a high temperature when the various developers fail to work according to the much standards, a darkroom tank has advantages of its own. Such a tank, which I made at a triffing cost for use in Florids, has given perfect satisfaction.

The dimensions of the tank will vary with the size of the film. Cyprem 14 in. thick should be used, and the made width of the tank should be about 3 m., the depth 1 in, more than the width of the film, and



The completed tank and detail of the central film support

the length 14 in longer than one quarter the length of the film. Screw the pieces together and paint the tank with several coals of parafiln inside and out, or, if possible, boil the sides and bottom in parafiln before assembling

The combined cover and hanger is made of 34-in, hard wood in which are inserted four pickel-plated boits to serve as supports. These boits are so placed that they will be 34 in, from the two sides at each corner. If the boits are threaded for their entire length, it is well to wrap them with a layer of cheesecloth to prevent the threads from scratching the back of the film

From sheet metal, make a central film support, as shown. The points are phonograph needles soldered to the metal. For the best results, this piece should be nickel-plated, which a jeweler will do for a few cents. The part is attached to the cover between the botts at one end.

The tank is filled with developer to within 14 in. of the top. The end of the film is bent around post No. I and fastened with a brass pin. Care should be taken that the film side is out. It is then passed over post No. 2, behind the points of piece No. 3, which should piece the film; then over post No. 4 and back to post No. 5, where the end is pinned.

The use of piece No 3 instead of another boil, is what makes it possible to thread the film in this way, so that there is no obstruction against the face of the film to retard development. The film is then lowered into the tank and left the requisite time,

Any one who has tried to paint new galvanised iron pipe knows how difficult it is to make the paint stick. This can be remedied by cleaning the pipe, preparatory to painting, with a solution of water and ammonia in equal parts.

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THE HOME WORKSHOP

How to Insulate Radio Parts and Tool Handles

AS AN insulation for electric switches, sockets, knobs, switch blade handles and screwdriver and plier handles, the home worker can use bits of broken phonograph records melted in a doubte boiler similar to



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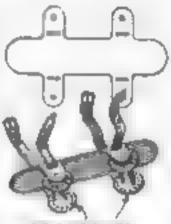
a gluepot. The material is a good insulator and adherm perfectly to clean metal.

It is not possible to obtain a thick conting by dipping an object ones, but repeated dippings will result in as thick a layer as desired. The container shown is simply a pint can with a wire rim soldered to it. so that it can be suspended in a quart can filled with water kept hot over a stove, This arrangement prevents overheating the composition.—F L. J.

Old Bicycle Hubs Serve as Roller Skate Wheels

ANY boy can readily make for himself a pair of roller skuten by uning old bieyels hubs and heavy gal vanished sheet iron as a foot base

Cut the abset iron the size and shape of the foot. leaving care with clote for straps. Bend the cars over as shown. to extend shove



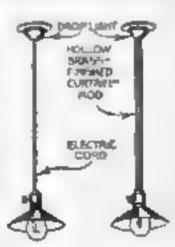
DID BETTERS HUBS

It costs little to improvice these skates

the foot-base 1 in Small, heavy steel bassings wheels, often sold for 5 cents each, can also be used -C. A. BLACK, JR., Hightatown, N. J.

Improving Proplights

O IMPROVE the appearance of electric droplights, purchase hollow brass curtain-rods large enough for the lamp cord



have send

to be threaded through them. Each rod, which consists of two partualiding one on theother, will serve fortwo drop lights.

If the cord is too long after it has been run through the curtain-rod, as ahown, cut it off. and if the rod le too long for the cord, cut the rod. -A. LEWIS, Regina, Back., Cun.



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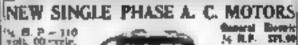
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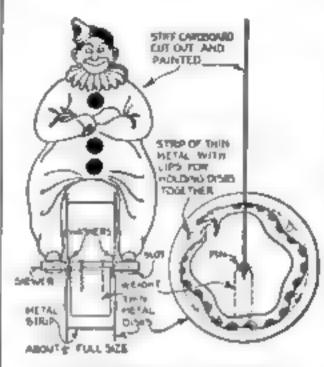
STATE AND SITH STS., CHICAGO, U. S. A.

THE HOME WORKSHOP

Trick Clown Rides a Wheel without Falling Off

A NOVELTY that will amuse the kiddles and often puzzle grown-ups can be made as shown below

The clown, which is cut from stiff cardboard and painted, is fastened to a short



Front and side views of assuming railor tay

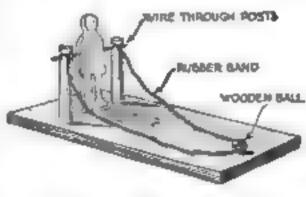
length of a butcher's skewer or other round attack. The stack forms an axis for the wheel, but has a lend weight attached to it so that, no matter how the wheel turns, the clown remains upright. The exis must turn freely so that the figure will not tand to go around with the wheel.

The details are clearly indicated in the illustration .-- D. W. CLARK, Buffalo, N. Y.

Sling-Shot Target Toy Provides Endless Fun for the Kiddies

THE illustration shows a clever toy that may be made in a few minutes by the hundy man. Pirst, a little wooden man is cut out, and a piece of heavy wire is passed through him as shown. Two posts are then mounted on a board, with two holes drilled through them at the top.

The wire that was placed through the little wooden man is placed in these bolen



The ball is shot at the target to make the figure spits around

and the posts are then inserted in the holes in the base of the device and glued there.

Attached to the two posts is a long rubber hand upon which is mounted a little wooden ball with a hole through it.

When the hall is pulled back and allowed to fly forward, hitting the little man in the right spot, it will make him topin around rapidly.—G. Bezchez, Jersey City, N. J.

How about the corncob?

The old family meerschaum stirs no thrills in this smoker

"Dear Sirs and so forth," begins a letter we recently received from H. T. Spenser, Madison, Wisconsin, "I am cupping my hands in the shape of a megaphone and shouting a loud echo of approval to your correspondent who smokes a merrichattin pipe fifty years old "But I don't want him or any other

"But I don't want him or any other moker to get away with the idea that a meerschaum is the only pipe where Edgeworth memoryned.

"The medicorright

EDGEWORTH

"For, you see, I am a corncob smoker.
What's more, I am a
corncob - Edgeworth
smoker?

The cornects

Eigeworth combination is hard to beat. I have tried almost
every combination of
the and tobacco there

is and have yet to find one that can approach at for year-to-and-yearout pipe amaking. "So if you're

"So if you're starting a Corncob - Edgeworth Clan, don't forget to put me down an acharter member."

We are continually being surprised by smokers who discover things about Edgeworth that we don't know ourselves. For instance, we never suspected that Edgeworth smokes any better in a corncob than it does in a briar. Frankly, we don't believe that it does. At any rate, we have any number of friends who claim that Edgeworth in the only tobacco to use in briars, in calabashes, in merschaums, or melave.

In smoking, we believe, it is every man

to his own taste

EDC BWORTH

That's one of the reasons why we don't try to make all of the tobacco that is smoked in pipes. We know there are men who have perfectly sound reasons for not liking Edgeworth.

At the same time we know there are any number of men who would like it if they only had a chance to try it once. That's why we are always glad to send free samples.

If you have never tried Edgeworth, send us your name and address on a postcard. We will forward to you unmediately free samples of Edgeworth Plug Slice and Edgeworth Ready-Rubbed. If you also include the name and address of your tobacco dealer, we will make it easier for you to get Edgeworth if you should like it.

For the free samples, address Larus & Brother Company, 59 South 21st Street,

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To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brether Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size Edgeworth Plug Shoe or Ready Rubbed for the same price you would pay the jobber.



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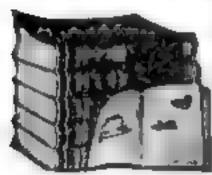
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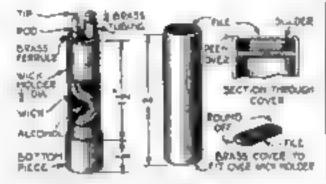
And division in

THE HOME WORKSHOP

How to Make a Durable Pocket Cigar Lighter

THIS handy pocket eight lighter can be made from a few small pieces of brass tubing and a friction gas-stove lighter The tip, the file, and a small piece of wire rod are the parts obtained from the stove lighter. The tip is removable and can be replaced when worn down

The body and cap are two pieces of telescoping bram tubing, the inside tube about 14 in. outside diameter, although a little larger or smaller size could be used. The lighter when closed is about 214 in, long. The top of the cap and the top of the bottom pieces of the wick container are 1/32in, sheet brass carefully filed to size and



Striking the gas-lighter tip with the the makes a sparie that ignites the wishing

soldered necurely in place. The wick collar, made of 14-in, braun tubing, is soldered -together with the small ferrule that supports the wire—to the top-

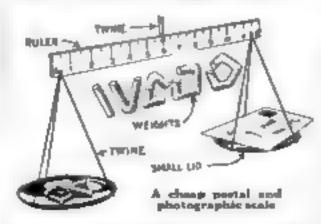
The file is cut down on an emery wheel and the ends are rounded and beveled so se to fit within the tubing of the cap. After the file is in place, the tubing u clinched over the ends of the file and the spaces on both sides are filled with solder Wicking thoroughly saturated with alcohol is inserted through the la-in, collar and pushed in until it practically file the container. The lighter can be highly polished and given a thin coat of lacquer or shellac

The tip is struck with the file and the resulting aparks ignite the wick. Replacing the cap estinguishes the flame 11 CLAUSES GREE Livin III.

Small Scale and Weights Quickly Made for Home Use

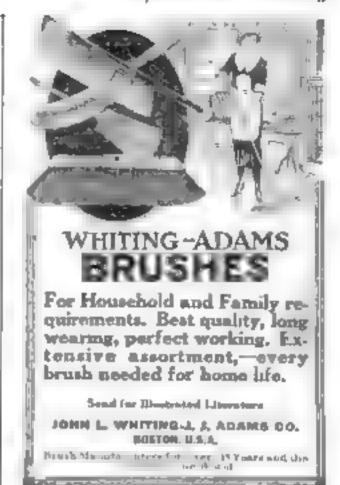
BRASS were de rod, a ruler, and two tin simple scale for postal or photographic uses or for weighing small amounts in the home workshop.

The weights are made by obtaining a piece of wire that weighs exactly a certain. number of grains and dividing it into pro-



portional parts. A piece of rod is similarly cut up to represent ounces. The shape of each piece indicates its weight.

The scale is a balanced ruler or a bur with two small lids attached to its ends with string, to serve as pans.—F C. D





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THE HOME WORKSHOP

How to Set a Jewel in Your Fountain Pen Clip

JEWELED pen or pencil clip is a novelty that can be duplicated with little difficulty or expense. The jewel is set in the ball of the clip and the method is such that any home worker without previous

TAREL HOLE -

PLASTER CE PARLS

JEWEL WECKED PA

HOLE FROM BACK

CLIN'S

Pleater of Puris holds the gass in place

experience can do the work.

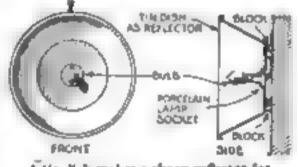
A hole is bored part or all of the way through the clip and into it is dropped a mixture of plaster of Paras and water, The jewel is then placed on the plaster and the clip in put ande for a day to dry. If the hole is bored all

the way through, it should taper toward the front a little so that the gem may be put in from the rear and driven forward until it is wedged firmly in place. If it is set by this method, It cannot fall out unless it is pressed from the front .- J. L. DOUGHERTY, Toledo, Ohio.



AN INEXPENSIVE but effective method of Illuminating the private garage for making night repairs is shown in the accompanying drawing

In the forward end of the garage is placed a fixed lamp socket surrounded by a cheap



A Lin dish makes a cheep reflector for night repairs in the garage

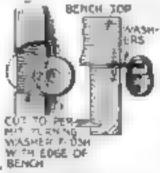
bright tin dishpan. With this improvised reflector, a 32-candispower electric-light bulb provides a good light .-- G. A.

A Bench Drawer Hasp that lan't in the Way

IT 18 not usually desirable to use a hasp on the face of a bench drawer, because it protrudes and is in the way. Booner or later it is bound to catch and tear the overals or clothing

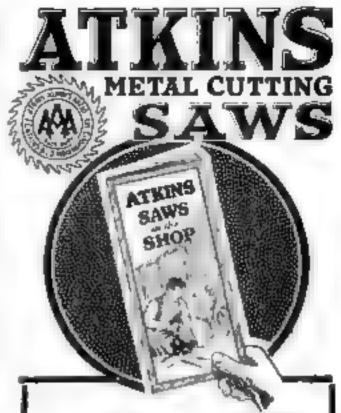
A heap that does not project can, however, be provided very easily by pivoting a

large washer on the top edge of the drawer and another washer in line with it on the under side of the bench top. If a recest in cut for these washers, as shown, they may be pushed back out of the way when the drawer



blade with two weabors

is not locked. Since the screws are concealed when the drawer is locked, the washers cannot be removed by any one trying to force the drawer unless a piece is broken out of the drawer front.-N H.



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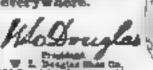
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Address

How Our Earth Was Formed

(Continued from page 38)

future from the stora? Is our earth destined to period in a stellar collecton, to die on A som born in the Kaming cataclusm of two stars that chance to come too close together?

Perhaps it is, but such a flaming doom is far from imminent. The nearest star is some 26 trillions of miles away. For the sun to go so far will take over 60,000 years. Even this is far too short, for we are not moving in this direction and even the more distant stars toward which we are moving are moving also. Long before we get there, they will be gone. Other stars, of course, will have moved in to take their places, Perhaps one of these is destined to hit us. but space is wide and the chance is small.

I have compared the stars in space to gnata flying about in a room. If the gnate are as far away from each other, on the average, as the stars are, there will be about seven gnate la a room two miles squere. You can imagine that there will be amail. chance for two gnats accidentally to bump into each other Probably life's record in the future will be even longer than its record in the past.

And what is this record of life's past? . That is the story we are telling in this serial; the story last month, of how life began; the story, next month, of how man arose out of the lower creatures.

When Life Began

When the earth was fully formed and had grown cool enough for life, when the ocean was ready, when there were rocks and a seashore and an atmosphere clear enough for the sun to shine through, then life began. We find its traces in the oldest rocks, the ones at the very bettern of the plie of geologic strate. A little higher in the pile we find more complicated creatures -worms and shellfish and the curious buglike trilebites, who dominated the sees for parhaps 200,000.000 years.

But was life to go on forever in the seas where it had begun? Was the land never to be conquered by higher forms of life? Was man himself never to emerge as the masterpiece of evolution among innumerfalamina grdlawb bnal elda

These questions would not have been answered as they have been but for the blind afforts of a curious rare of fishes, which, in the next article, we see striving to perfect their bodies so that they could conquer a new realm for life. We see how they struggled generation after generation, age after age, to learn to breathe air instend of water; and how Nature finally conspired with them to perfect one of the most revolutionary inventions of all time the invention of the hings.

■ Next month - Men's Animal An-* peetors; Pils Parmity | rec another thrilling story in this amazing series! Simply and understandably, Doctor From will tall the most absorbing mystery and most fescinating romance of science-life and its conquast of the world. His story is big, vital and interesting.

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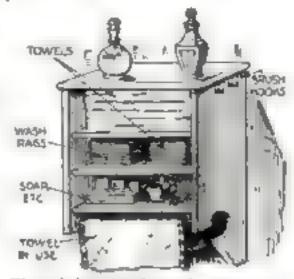
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THE HOME WORKSHOP

How to Build a Large Cabinet for the Bathroom

A LINEN shelf or cabinet for the bathroom, large enough to provide ample
room for towels, washrags, toilet accessories, and other items for which there is no
place in the usual small medicine cabinet,
can be made in a few hours with a few 1/1in, white pine boards.

The ends are dadoed into the top and the shelves are dadoed into the ends for % in., but saids from this, the construction is of the simplest possible type. The top is a

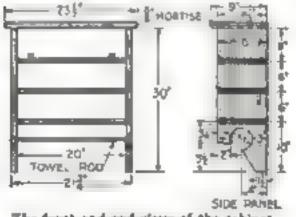


These shalves provide ample storage space for towals and bathroom assessmeles

carefully selected piece, free from knots. 9 by 28 ½ in. The edges should be rounded nearly, either with a sessing or molding plane or with an ordinary plane. In the latter case, a templet can be made by boring a ½-in, hole in a piece of cigar-box wood and cutting the piece so that half the circumference of the hole will form a gage. Each of the shelves is 8 by 20 ½ in. If any of the stock has knots or is otherwise defective, it should be used for the shelves rather than the ands or the top.

If time permits, a pair of doors can be made, either with glam or solid wooden panels, or a single door with a mirror

When the pieces are ready to be asnembled, the joints should be coated with



The front and end views of the cabinet, fully dispensioned

hot give and the whole clamped together true and source until dry, or a few finishing nails can be used to hold the pieces together while the give is setting. The cabinet is then carefully sandpapered, given a priming coat of white paint; the boles, if any, are puttied, and several coats of the best quality white or cream enamel are applied.

Two wall plates are let into the back edge of the upper shelf, as shown, and are screwed against the wall. If the wall is plastered, it should be tapped to locate the stude, and the screws should be set into them to make sure of a firm support.—Jos. V ROMG.

Play a Conn For Pleasure and Profit

Take a tip from such popular artists as

TED LEWIS, the femous justical clown, who says many of the effects he gets are possible only with the Costs assophone;



PAUL BIRSE, renowned soleist and Columbia record maker, who with his orchestra members says Conns are the last word in perfection;

DON BESTOR, director of the popular Benson orchests of Victor record fame, which is exclusively equipped with Constantiveness;

PRANK Westphal, whose Rainbo Gardon orchestra makes records for Columbia, and all members of which acclaim Conn supremacy.



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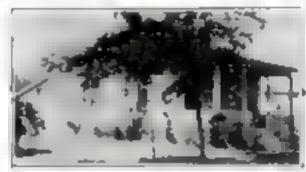
THE HOME WORKSHOP

He Made Money Repairing an Old Cottage in Spare Time

WHEN other men are in the "gym" or playing tennie or golf. I am in my home workshop. I take my exercise in that way, and my shop, besides "keeping me 6t" and giving pleasure, brings in considerable money throughout the year.

On one occasion when I ran out of other work, I bought a small cottage that hadly needed repairs. The house had a sitting room, dining room, two bedrooms, kitchen, and bath, and while it was not particularly attractive, I had the idea that I could fix it up and sell it when completed at a price to repay me well for my work.

The changes upon which I decided were these: To put in a furnace, tear out a partition in the kitchen and make a breakfast nock, cut in extra openings for double windown, repaper all the rooms, paint the kitchen and dining room with white enamel, build in a china suphoard opening in both kitchen and dining room, overhaul the plumbing, lay new floors over the entire



This house, remodeled by the sweet, sold for \$1500 more than it seet

house, convert a rear lean-to into a sewing room, and arrange the besement for a furnace, coalhin and vegetable storeroom

I had to rebuild the foundation of the chimney to make possible the installation of a furnace in the cellar. I had a boy help me with this work, and then put in a pit and furnace foundation and cemented the fluor. Later I partitioned off a coalbin and vegetable room. The furnact itself was set in place by the dealers.

Next, I had the plumbing repaired and a new kitchen sink and hot water tank installed. Cutting in the extra windows immediately made the interior more attractive, and by converting the pentry into a breakfast corner, the kitchen was enlarged

and made more serviceable.

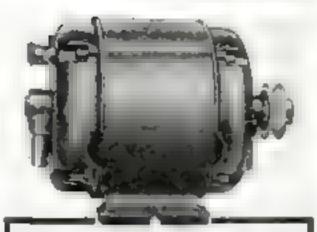
I then wired the house for electricity, finished all the carpentry work, except laying the new floors, and painted or varnished the woodwork. When the papering was finished, I laid a thin maple flooring, sanded it with a floor machine, and gave it three coats of varnish. The light fixtures, pretty but not very expensive, were put in last.

The entire cost of repairs, including good pay for my own time, was less than \$1000. We hard the house so well that we lived in it ourselves for two years, and then sold it for \$1500 above the purchase price.-FRANK W. SHULTIS, Lanning, Mach.

Reconditioning Coment that Has Been Long in Storage

CEMENT that has been stored for a "warehouse set." It can be reconditioned by rolling or dropping the macks on the floor, provided it has not been spoiled by dampness.

Lumps that cannot be crushed by hand should be discarded.—C. L.



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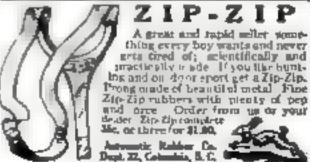
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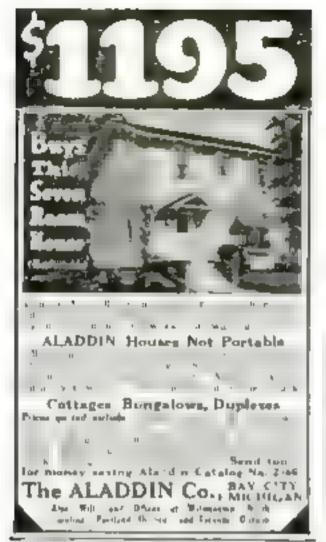
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Six of Your Most Pressing Radio Questions Answered

By the Information Editor

"HOW can I improve my radio set?"
This question in some form is the subject of 700 of every 1000 letters I receive as Information Editor of POPULAR SCIENCE MONTHLY. And this is the question eternally uppermost in the minds of thousands of radio fans.

Curiously enough, almost equally numerous are the two main trends taken by questions of this kind, "How can I increase the distance range of my set?" is the most frequent ples from the radio fan, and "How can I increase the volume of sound from my set?" closely follows is

There are many answers, of course, to the first question. In general, it is sale to say that by a close study of the design of a radio receiving set, it is possible to receive over distances of from 500 to 1000 miles, merely by using a detector and one stage of amplification. As a matter of fact, 1000 miles is often covered by the use of a single detector tube.

In the construction of such a set, enreful attention must be given to the tuning elements, since at these great distances, solectivity is of primary importance. A set that will not tune very closely cannot be

used to span great distances.

This selectivity can be obtained by the use of a variocoupler-variometer book-up or a variocoupler with an extra rotor, the wanding of which acts as a tickler coil. The primary of the variocoupler should have just about the required number of turns to receive efficiently the programs sent out on the broadcasting wave lengths. means from 25 to 35 turns on a tube \$14 or 4 in. in diameter. By tapping off every turn between the twenty-fifth and thirtyfifth turns, it is possible to vary the wave leagth of the circuit to rather close limits. To vary it within the limits of one turn, a Vernier variable condenser can be used either in parallel or in series with the primary cod

The secondary coil should have about 50 turns and the tickler coil, 70 turns. Where the variometers are used, they should have from 30 to 60 turns on the primary and approximately the same number on the

"What is the actual value of a potentiometer, and how can it be connected into the circuit?" is a question that has come to me hundreds of times.

When the ordinary type of B battery, tapped in the last few cells, in used, the difference in the voltage can be varied only by 114-volt steps. A potentiometer makes a finer adjustment possible. To book one into a standard circuit, it is necessary to connect the negative of the B battery with the moving member, or slider, and the perative of the storage battery with one end of the potentiometer, while the positive pole is connected with the other and of the resistance element of the potentiometer. The plate voltage can then be varied within small limits by moving the slider of the potentiometer from one end of the resistance element to the other.

"How are Vernuer condensure connected into a circuit?" troubles many of my correspondents.

Vermer condensers simplify the critical tuning of the set. Most radio fams have

(Continued on page 124)

A New Butter-Kist Popcorn Machine at Half Former Price!



HERE'S a marvelous moneymaking opportunity—a beautiful, new automatic Butter-Kist Popcorn Machine at helf what former models cost.

For a small down-payment this new Gold Mine Model will be shipped immediately to any responsible retailer. Within a few hours after in receipt you can be earning big profits, selling the world-famous Burier-Kist Popcorn, out of which you should easily and quickly pay the belance.

The "Gold Mine" is a becuty. Attractive mahogany-finished cabinet. Handsome glass sides. Highly pollabed nickel parts. Takes up little room. Feeds, discharges, pope and butters the corn automatically. Keeps the corn warm and crisp after popping. Produces thirty 10-cent packages an hour,

Butter-Kist Popcorn sells fast. It's nationally known and advertised. People go out of their way to buy Butter-Kist. Out of every dollar's worth you sell, you krep 65 cents as your profit! F. J. Studer writes, "My Butter Kist Popcorn profits have averaged over \$900 per year for six years". R. C. Huegg says, "First six months" sales went over \$2500". Many are making even more.

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Your Radio Questions

Continued from page 123,

had the experience of bringing in a station without being able to tune it in to best advantage because a very slight edjustment would lose the station. To overcome this difficulty, Vernier condensers should be connected in parallel with condensers already in use

Typical of questions that come under this division of how to increase the range of radio sets are, "Should the retary plates he connected with the ground or the serial side of a circuit?" and "Should the condenser be connected with the ground lead or the earial lead?"

Wherever possible, the rotary plates should be connected with the grounded part of the circuit. In a secondary circuit, the lead from the secondary coll going to the A hattery should be grounded and the rotary condenser plates thould be connected with this side of the circuit. The reason for this is that the rotary plates are the ones connected with the shaft of the condensers and a certain capacity effect is introduced between the hand that is grounded and the part of the circuit to which the rotary plates are connected. If the rotary plates are connected with ground, however, this capacity effect will not be present.

This covers pretty fully the main types of questions I receive as to how to increase the range of the set without resorting to the use of radio frequency amplification.

"I am getting pretty good results." say the other great group of my correspondents, "but I'd like to know how I can make the music come in as loud as a phonograph."

In order to get greater volume, it is often necessary to use two stages of amplification for use with a loudspeaker, and if you "went it as loud as a phonograph," it may be necessary to use three stages of audio frequency amplification, as described on page 98

It is often advisable to use what is termed a "grid biasing" or C battery. This may consist of about five flashlight cells connected in series, or a small 2234volt B battery may be used. The positive 2214-volt terminal is connected with the negative of the 22 le-volt detector or B battery The F terminam of the transformers, instead of being connected with the A battery filament mrout, are connected with the various taps or binding posts of this new bissing battery. Experi-menting with various values of battery voltage will soon show the values that give best results with a given amount of plate tuitage

These, then, are the questions that come most frequently to the deak of a busy radio miormation editor. What is your Grouble, and what question do you most want answered?

Can You Figure Pulley Diameters?

MULTIPLY the number of revolutions of the driven pulley by its diameter and divide the product by the number of revolutions of the driven, in order to find the diameter of the driver Conversely, to find the dumeter of the driven, multiply the number of revolutions of the driver by its dismeter and divide the product by revolutions of the driven.

The Shipshape Home

Hose to Do the Odd John

Removing Wallboard

To amove wallboard with a clawbammer or a nall pullet in such a way that it is not eracked or disfigured

is next to impossible. It can be done, however, by outting out the waliboard around the nails with a steel tube, as abown

When the wallboard is off, it is a eimple matter to pull the nails with hammer pincers or nail puller,

The tube should be slightly larger in diameter than the beads of the nails, and if the cutting end is sharpened, it will go through the board more easily The holes do not prevent the wadboard being used over again for any

work where the joints are covered by strips. - W. A. Sava, Cambridge, Mass.

Spring Painting

By TAKING advantage of your space time on a few plassant spring days. you can do much to lmprove the appearance of

your house. Doing your own painting an for an possible saves money and a successful result is certain if the surfaces are properly prepared, a good grade of paint is used, and the paint is brushed vigorously into the pores of the wood and spread in thin, unform coats. The tendency of smaleurs is to put on too heavy coats, which look well temporarily, but are apt not to dry thoroughly and therefore crack and sometimes prevent the surface from being repainted until the old pigment has been burned off

Scrape off all old, loose paint with a wire brush, putty knife, or scraper. If the gurfaces are greasy or very dirty, they should he washed with soap and water. If the wood has not previously been painted, coat with sheller all knots and sappy places

Prepared paint should be thoroughly mixed by first shaking the unopened can, pouring about two thirds of the thin top liquid into another can, stirring the remaining oil and pigment with a stick until the mam is uniform, and gradually restoring the thinner vehicle until the whole is thoroughly mixed. Then pour the paint from one pail to another a number of times.

The brush should be kept moderately filled with paint and applied to the surface with a horizontal motion. The first cost over proviously painted surfaces, especially if hard and non-absorbeet, should be reduced somewhat with equal parts of turpentine and raw linseed oil. On new surfaces or old surfaces that are absorbent, raw linseed oil should be added to the first and second costs in quantities sufficient to fill the wood well, and a little turpenting can also be used profitably. Its purpose in the first coat is to insure the paint penetrat-

(Continued on page 126)

Let Me Make A Man of You



LIONEL STRONGFORT

Dr Bargant, of Marvard de-clared that "Ecrompton to singuistionably the Breat greatmen of physical de-missional page page 1

Are you dragging younged about from the to day always alling and com-plianting always three and dragmedicus studying from Bacharda Tudages-ain merupation Dysperant. Networkstem that better two error point high-reasons abreving up at fare- you tack of one up in your eyes? Have you and must fareity up on up being that you will over up a real man again, while a mercant and appropriate the any hing in the world. Have you had always also the man again, and which and afterwed your position are the man I want to help,

Pull Yourself Together

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Come to Me in Full Faith as You Visuid to a Brother

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Physical and Health Specialist Dopt. 227 Founded Howark, New Jorsey

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of Radio



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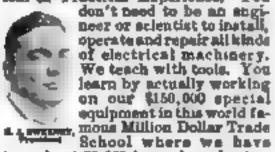
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THE HOME WORKSHOP

The Shipshape Home

(Continued from page 125)

ing properly and, in the second, to reduce the gloss.

After the first priming coat is dry, fill all nail boles, cracks, and crevices with pure haseed oll putty.

If paint gets on the window panes, it can be removed either by acraping with a safety razor blade or softening with a paint and varnish remover or hot acid vinegar.

If gloves are not used to protect the hands, cost them with vaseline or with a beavy scap lather well rubbed into the porce and allowed to dry .- F. T. B.

"Nailing" Plaster

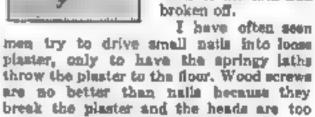
To PASTEN in place plaster that has come loose from the laths, I use what I call "screw nails." They are made

from large headed roofing nails, as shown The threadlike groove is cut with a small rattall file, the head of the neil being held with pincors. When the thread has been cut as far as needed, the nail is placed in a vice and the ecrewdriver slot made with a nackuaw.

Holes are made in the loose plaster with a small bradawl and the nails are rubbed on a cake of old laundry soap and then ecrewed through the plaster into the laths. The heads, being large and very thin, hold the plaster firmly and yet are invisible when the wall is papered.

Fifteen years ago I used these pails to fix cellings that were loose and looked as if

they were ready to drop, and they are still in good condition. The plaster itself was good, but the clinchers on the back of the lath had



email.—JOHN R. DODUB, Normal, Ill. Making Screece Hold

A scalew that has been taken out and put in so often that it is loose, can easily be made to hold by winding a

length of soft copper wire around the threads, as shown. This has the effect of increasing the diameter of the threaded

part and usually will serve the same purpose as plugging the hole or tunne a larger screw. The "kink" m a particularly useful one in rehanging screen doors and storm doors or dresser mirrors.-A. W. K.



Removing "Bloom"

IF THE piano case develope a surface film. known as "bloom," wipe it off with cheesecloth mointened alightly with

a few drops of alcohol, and immediately rub gently with a noft, dry cloth. If this treatment is persisted in, the bloom will become less and less troublesome.-F H



THE HOME WORKSHOP

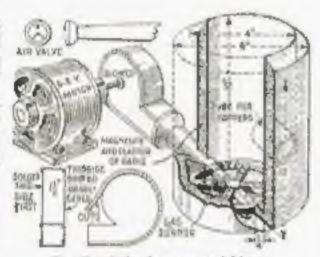
Small Blast Furnace Burns Coke or Charcoal

FOR those jobs that require more heat than a gasoline blowtorch will furnish, especially if gas is not available for fuel, a small blast furnace for charcoal or coke may be made at little cost, as illustrated. Its use is not restricted to the house, hecause the blower can be run from an auto storage battery. It will melt 10 lbs. of lead and heat a pair of soldering coppers in 15 minutes, and is therefore a valuable furnace for tinners and plumbers.

The body is a coffee canister and the air inlet is a burner from an ordinary gas stove or gas plate, which may be obtained from a junk dealer. Cut two vertical 2-in. slits in the tin at the hottom about 114 in. apart and bend out the piece between them.

Fill the bottom 1 1/4 in. deep with a mixture of either 3 parts magnesite and 2 parts plaster of Paris, or 4 parts fire clay and 1 part ordinary clay, with sufficient water to form a thick paste. Put in the gas burner and push it down until it rests level on the bettom. Then bend down the small flap and cut it to fit the pipe.

Obtain another can that will fit in the canister with about 1-in, clearance all



Details of the furnace and blower

around and cut out the bottom in such a way as to leave a 34-in. rim all around, as shown. Push down this can until it rests on the burner and pour in the slot between the cans a solution of either of the previously mentioned mixtures with a little water added to make it thinner.

If soldering coppers are to be heated, a hole should be made about 5 in, from the bottom and lined with metal tubing to make a nest job.

The construction of the sheet metal blower, which may be permanently connected with the furnace or not, as preferred, is made clear in the blower detail. If the last side to be put in place is to be bolted on, solder the nuts on the inside so that they cannot turn. The fan can be made of sheet metal or obtained from any electric repair shop that handles vacuum cleaners. A small battery rhecetat will be found useful in operating the blower.

Brase may be melted in this furnace by starting the fire and putting the crucible right in the coals. Then pack more coal around the sides, cover the furnace with a lid, and start the blast. If soldering coppers are to be heated, start the fire with the blast, shut off the air, and then put in the coppers.

This furnace may be used safely indoors, although it is a wise precaution to put a heavy piece of metal or asbestos under it. -STANLEY TRIES, Whitefish Bay, Wis.



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HE poet who sang so sweetly of "the delicate odor of mignonette" as reminding him of his sweetheart never dreamed that, in modern times, most perfumes would be derived, not directly from flowers, but from the chemical treatment and blending of natural or artificial odorous substances. Thus, the scent of blacs is produced from oil of turpentine; and the preparation of a substance called "ionone" yields the odor of fresh woodland violets! The story of the creation of every scented article-from toilet soaps and powders to the delicate suggestion of perfume in feminine notepaper-is a romance of chemistry in which temperature control plays a vital part. One of the most important things that must be determined in regard to the essential oils that are the basis of many perfumes is the boiling point. Also, at each different temperature in their distillation, a different product results from the same process. If sense of smell alone guided the perfumemakers, the result might not please

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